Municipal Engineering

Design, Construction, Operation and Maintenance of All Public Works

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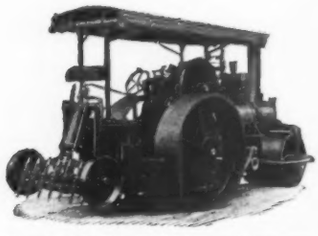

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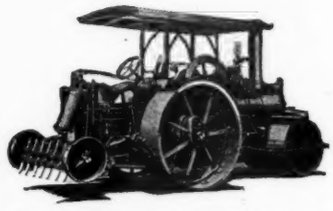

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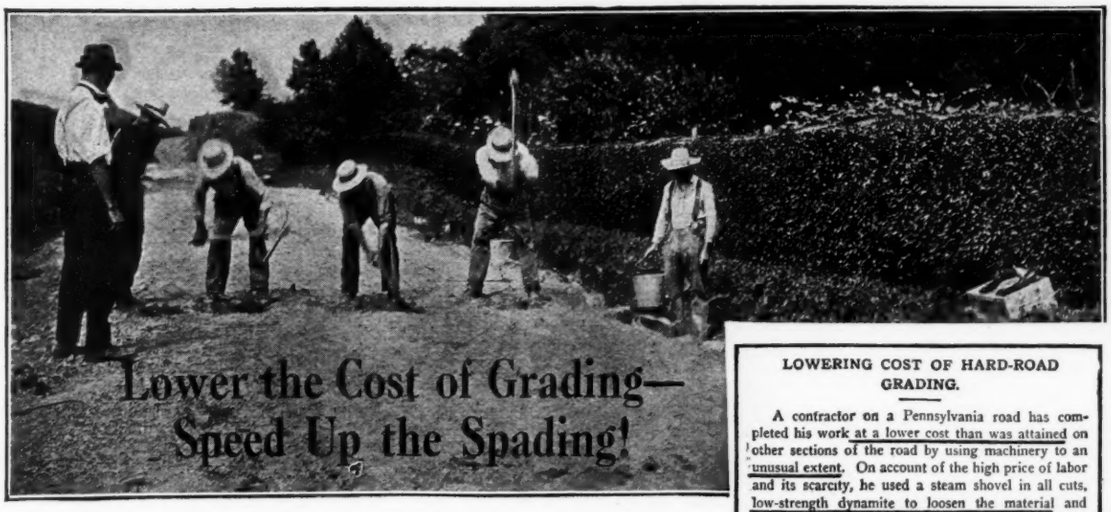

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It contains more than three times as many permanent properties as the next best oil. It cannot leave the wood under the most severe climatic conditions.

For paving and for ties, this oil is without an equal.

Republic Creosoting Company

INDIANAPOLIS, INDIANA

Plants: Indianapolis Minneapolis Seattle Mobile

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Ohio Quarries Co., The

Sign Posts.
Cutter Co., Geo.

Sluice Gates.
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Sprinklers.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Curbing.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Flagging.
Cleveland Stone Co.
Ohio Quarries Co., The

Street Cleaners' Carts.
Holzbog & Bro., Geo. H.

Street Cleaning Machinery (Horse Drawn).
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Austin-Western Co., Ltd., The

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Surveyors' Instruments.
Kolesch & Co.
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Sweepers.
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Tamping Machines.
Pawling and Harnischfeger.

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The Barrett Co.
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Tar Heaters.
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Howard, J. W.
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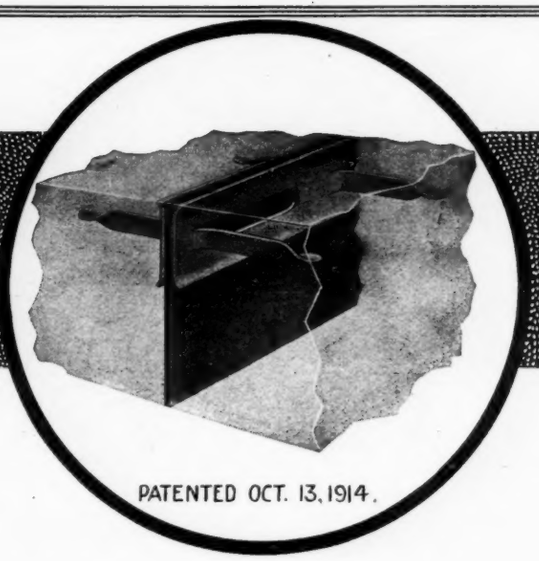
TO WIN, BOTH MUST BE KEPT SMOKING.

(Courtesy Chicago Daily News.)

Specify

BAKER IMPROVED ARMOR PLATE



BAKER BEVEL EDGED ARMOR PLATE (⅛x2½ ins.) ACCURATELY CUT TO LENGTH AND CROWN, WEARS DOWN EVENLY WITH THE PAVEMENT.

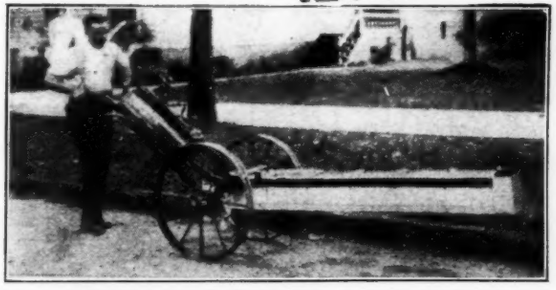
NO DISINTEGRATING OF THE CONCRETE BACK OF THE PLATE BECAUSE THE BAKER IMPROVED ARMOR PLATE DIRECTS THE blows of traffic downward and not along the surface. Illustrated particulars tell the story and describe the advantages of the Baker Installing device, whereby you can obtain a perfect joint. ***Immediate Shipment Guaranteed.***

R. D. BAKER COMPANY

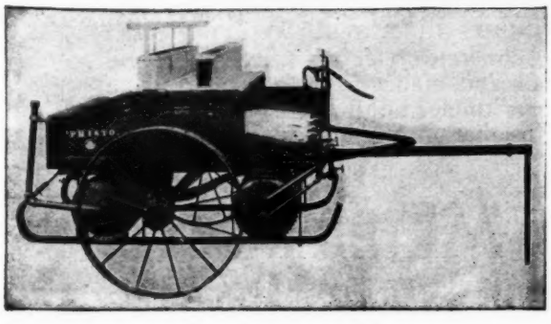
Penobscot Building. **DETROIT, U. S. A.**

NEW PAVEMENTS FROM OLD ONES!

The **"Pluto"** Asphalt Surface Heater will heat 36 square feet of sheet asphalt surface to a proper consistency for handling in from five to seven minutes. *One man* operates it, and the fuel required is six gallons of kerosene per hour.



"Pluto-B" (for repairing automobile ruts) heats a pavement strip six inches wide by nine feet long in from 3 to 5 minutes. Tank carries 9-hour kerosene supply for two burners. Strictly a *one-man* machine.



On a consumption of three gallons of kerosene per hour, the **"Phisto"** Tool Furnace will keep fourteen tools, three pails of binder and three shovel scoops constantly hot. It gives a cleaner flame of more intense heat than can be produced by any wood burning furnace and does away with the trucking of wood and ashes.

We have a full line of Surface Heaters, Tool Furnaces, Babbitt Burners, Torches and other special kerosene vapor burners.

ALGER SUPPLY COMPANY

Peoples Gas Building **CHICAGO, ILL.**

MATHEWS GRAVITY BRICK CONVEYERS

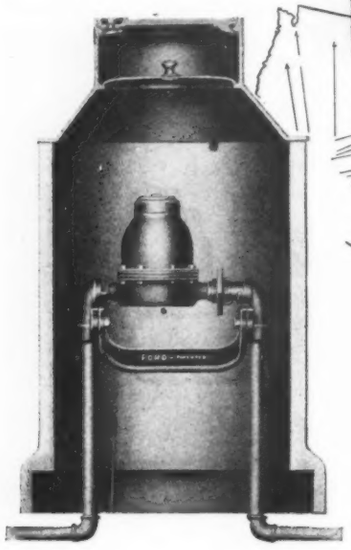
"Our (two 20-ft. sections) **Mathews Brick Carriers** and seven men place 43,000 per day—work which formerly required thirteen men. With the **Mathews,** one setter keeps three stackers and four handlers busy.

"Moreover, we always have exactly the right number of brick on the job. That cuts out rehandling! Saves us real money. Saves time of setters because they never need to wait for brick to come up to them." (L. H. Young Contracting Co., Youngstown, Ohio.

Get the whole of the Mathews story! We'll tell you the "hows" and "whys." We'll put you on the path to a bigger yardage with a smaller payroll. Write today for Bulletin No. 4.

Mathews Gravity Carrier Co., Ellwood City, Pa.

Ford Meter Boxes



The Ford Yoke makes connection with the meter in such an easy and simple manner that it will meet with your favor the moment you see it.

FROM all parts of the country comes the word that "no meter properly installed in a **Ford Meter Box** has ever frozen." During this last winter thousands of meters were "kept warm"—even in 40-degree-below-zero weather.

Send for particulars illustrating Wabash Steel Forms for making concrete meter box barrels. Simple and easy to operate and made in various sizes. The Ford **"Rams-Horn"** meter holding yoke will interest you—it's for the installation of meters on vertical pipes in basements.

The Ford Meter Box Co.
Wabash, Indiana, U.S.A.

Buckeye Berea Curbing Outlasts Pavement

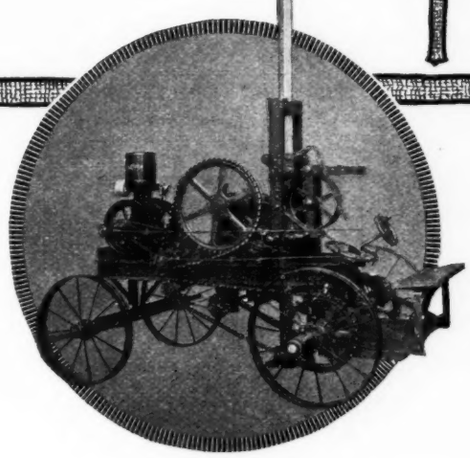
Curbing costs money! Why buy a new curbing for every new pavement when "Buckeye Berea" outlasts pavements? You may not be able to buy a pavement which will last for thirty years and over—but you can buy such a curbing! That's "Buckeye Berea" Natural Sandstone Curbing.

Here is still another street which could not withstand its twelve years of traffic—but its **"Buckeye Berea"** Natural Sandstone Curbing is as good as when originally installed. When this street is re-paved, the curbing will be re-set.

THE OHIO QUARRIES COMPANY

CLEVELAND

Compare the Force of these two Blows



"The 'P & H' Power Traction Tamper strikes forty-two 150-lb. (108 sq. in.) pile-driver blows per minute, whereas our best hand-tamper will not average twenty 10-lb. (19 sq. in.) blows in the same time. Compare the compacting force of *6300 lbs.* (per minute) with 200 lbs. (per minute).

"Hand tamping merely 'smoothens' over, whereas 'P & H' Power Traction tamping *thoroughly* compacts. We know that the work is not only ***thoroughly*** done, but that the job has been put through in the ***quickest*** possible time."

The "P & H" Power Traction Tamper (equipped with 9x12-inch tamping head) has a maximum cross travel of 16 inches, thus enabling it to actually cover 27 inches of trench.

Get details about the "P & H" Power Traction Tamper. You ought to be acquainted with this "slam-banger."

Pawling & Harnischfeger Co.

MILWAUKEE, WIS.

Gen. Goethals on Highway Improvements.

"I am heartily in accord with a policy which will permit highway commissioners of the various States so to plan their work that they will be able to undertake the construction of new highways and of maintaining the existing ones so as to relieve railroad congestion."

Build Permanent Highways and Save Upkeep

It is not enough to rush road building to relieve shipping congestion, but the highways must be so built as to eliminate maintenance as far as possible. Labor is so scarce that it should not be used for repairing roads.

The concrete road is permanent and requires practically no maintenance. **Kahn Highway Products** insure the best construction for concrete roads, for reinforcing, for permanent joints and for protecting concrete curbs.

Write today for Highway Pamphlet and estimates.

TRUSCON BUILDING PRODUCTS

TRUSCON STEEL COMPANY

(Trussed Concrete Steel Company)

Representatives in Principal Cities. **YOUNGSTOWN, OHIO.**

Warehouses in Boston, Chicago, Detroit, Moline, Philadelphia, Portland, Ore.

Kahn Road Mesh

Large, flat sheets, easily handled—no unrolling of coils nor cutting to length. The most efficient reinforcement for concrete roads and pavements.

Kahn Armor Plates

Perfectly protect expansion joints. The split end prongs assure positive anchorage in the concrete, and plates are correctly placed by our Improved Installing Device.

Kahn Curb Bars

Protect and reinforce concrete curbs. Strong, rigid, convenient, easy to install. Furnished straight or curved.

No Burned or Coked Asphalt or Clogged Pipes

The Steam Melting arrangement eliminates all danger. You cannot burn or coke the asphalt with a **"Merriman"** on the job. Trouble in the pipe line between the melting tanks and the weight bucket is cut out. All pipes and valves are steam-jacketed.

"Merriman" Asphalt Plants are built as One Car railroad, Two Unit portable and Stationary Plants of various capacities. Large drum and kettle capacity (a day's run in each kettle); independent power units (making it possible to use different parts of a plant independently); mechanically operated mixer at end of car plant, admitting wagons underneath.

The East Iron & Machine Co.
LIMA, OHIO.
The Pioneer manufacturers of Steam Melting Asphalt Plants

Winning Wars with Miles and Minutes

We must produce More! But one product is dependent upon another. Consequently we must keep the lines of communication clear. We must link our industries *closer* together. It all reverts to one solution and one alone. That is **hard-surfaced** roads.

They provide the only great outlet in quickening transportation with the aid of the Open Road and the Motor Truck.

Time is everything, and better roads mean more miles in fewer minutes. Boost for **hard-surfaced military highways.**

"Get on the Job, Men!"

Badge of Honor
to be given every U.S. Shipyard Volunteer

The Government is enrolling a reserve of 250,000 skilled workers for the Shipyards.

If you can handle a tool expertly —your name is wanted. Come —enroll today in the United States Shipyard Volunteers.

If selected, you will get good wages.

You will have a steady job—at work for which your special experience has fitted you.

The Government is spending millions to provide good houses for you.

You will be a War Worker.

Wear a Badge of Honor and have a Certificate—showing your readiness to do work just as vital, just as necessary as the man who goes to the trenches.

Enroll today—then stick to your job—you will be called later, when needed.

Do your bit—build a ship.

U. S. Shipyard Volunteers

Go to the Nearest Enrollment Agent of the

Public Service Reserve

of the Department of Labor

If there is no Enrollment Agent near you, mail the coupon.

FOR THE WINNING OF THE WAR

This space contributed by the publisher through the Division of Advertising of the U. S. Committee on Public Information.

For Further Information mail this Coupon

EDWARD N. HURLEY, Chairman
U. S. Shipping Board, Washington, D. C.

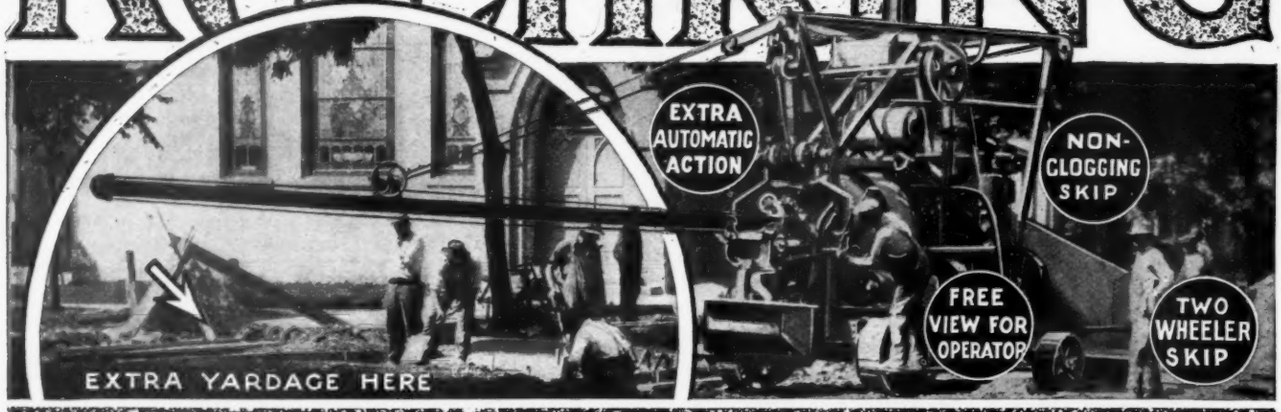
Please send me full information about enrolling in the United States Shipyard Volunteers.

Name _____

Address _____

Trade _____

KOEHRING



The Koehring Boom reaches up alleys and intersecting streets—a big time-saving *every time.* It is a time saver all the time, because it means a power-driven distribution of concrete, and gives the greatest distributing range without moving the mixer. Extra automatic actions exclusive to a Koehring boom and bucket system enables operator to give on-time attention to every duty and deliver top speed of mixer as a unit. The Koehring Paver with liberal drum dimensions, double wide high angle charging skip, fast discharge, boom and bucket distribution and heavy duty construction throughout, means *lowest yardage cost.* Write for booklet *U-1.*

Koehring Sizes in Cubic Feet Capacities

Mixers for construction work; 10, 12, 15, 20, 24, 30. 44. Equipped with low charging hopper, batch hopper and side loader.

Hot Mixers for Bituminous Pavements: 12, 20, 22. Side discharge type and end discharge type.

Paving Mixers: 5, 11, 16, 22. Equipped with distributing boom and bucket or spout.

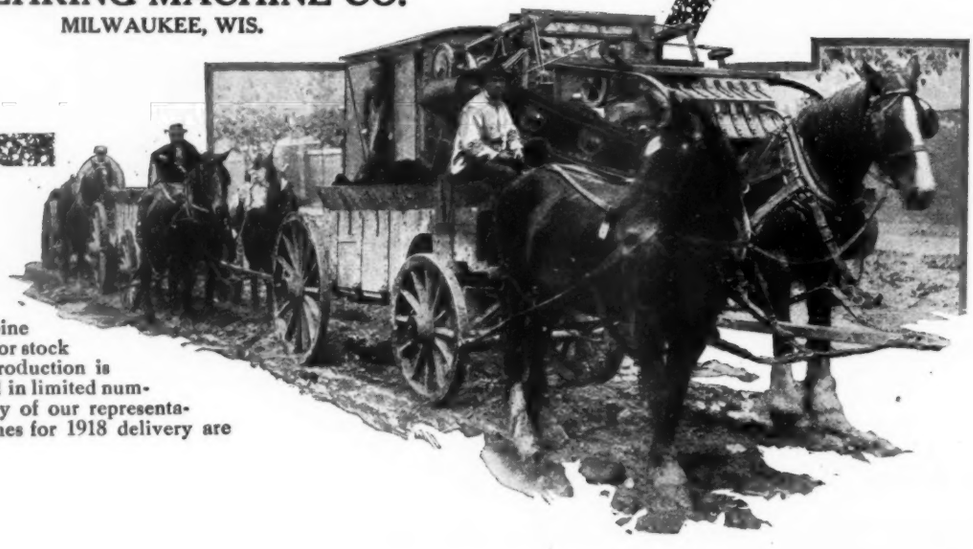
Gasoline Power, Steam power or Electric power.

DIGS TO GRADE AND LOADS 60 TO 100 CU. YDS. PER HOUR.

Digging wheel adjustable to cut from two inches to two feet—speed ahead regulated according to depth of cut. Tough clay has been dug to grade and loaded at .043 per cu. yd. Will dig out old macadam, and with screen attachment, will separate stone. This is a one-man machine—a revolutionizing cost-cutter for street and highway grading. Write for booklet *U-2.*

KOEHRING TURBINE GRADER

KOEHRING MACHINE CO.
MILWAUKEE, WIS.



The Koehring Turbine Grader is not built for stock—only to order—production is limited and allotted in limited number to each territory of our representatives—a few machines for 1918 delivery are still available.

The Highway Economist

VOL. III. APRIL, 1918. NO. 11.

AN ASPECT OF WAR OF VAST IMPORTANCE

The American eagle is a noble bird, and its warlike scream is supposed to strike terror to the stoutest-hearted foe. But the actual conflict is won by beak and talons.

The American eagle has but one head, while the Prussian eagle is double-headed. In a screaming contest, therefore, the American eagle is at a disadvantage.

Neither will making faces at the Kaiser win the war. Seen at a distance of 4,000 miles, a threatening face has no terrifying effect. Moreover, hiding in a cyclone cellar and crying "Peace!" will not induce the Kaiser to forego his designs of world sovereignty.

The rights of man and the fate of Christian civilization are being submitted to bloody arbitrament. The decision doubtless will favor the strongest battalions and the heaviest artillery. Faith is a beautiful thing. It sustains hope. But modern warfare is scientific. Results can be calculated with great accuracy if the terms of the problem are known.

So far the preponderance of effective men and of munitions and of science has been with Germany. With Germany war is almost an exact science. Very little is left to chance. Every movement is calculated and all movements are coordinated.

Germany seems surely to be wearing away the rock of resistance represented by the Allies. In men and resources and stamina the Allies are failing. The breaking point may be near. It may be reached this coming spring. The whole world is looking to the United States to save the day. *Will our aid arrive in time?* Everybody is asking the question. At the end of each month the question is asked less hopefully.

Events are fast crowding toward the supreme crisis. Germany, relieved on the east, is summoning all her resources in the hope of sweeping before her all resistance on the western front, by sheer weight of numbers.

The blow may fall before we can put in the field enough men to strengthen the Allies materially. Will the Allies be able to withstand the tremendous and persistent onslaught? So far as the Allies are concerned, the issue hinges on the throw of dice, rather than upon rational expectation of defensive strength.

How many effective men have we in France? The public does not know; but in view of the number of men still in camps and cantonments in this country, the public knows that the force in France must be pitifully inadequate for decisive action.

At the present rate of progress, it will require at least two years to equip and transport a million men, with their equipment and the guns and munitions required to make them efficient. Nearly everybody believes that it will take three million American soldiers to win the war; but unless these soldiers get into the game soon, the opportunity to win the war may pass.

Nearly one year has elapsed since the United States declared war, yet not a half million men are ready to be sent abroad. Probably not more than 200,000 men are suitably equipped and drilled. This estimate is, of course, no more than a reasonable conjecture.

Transportation facilities are notoriously inadequate. If we had a large army, we could not get it across the water within a year. It would require 400 transports, carrying 2,500 men each, to transport 1,000,000 men, and additional ships for carrying guns, food and munitions would be required. The ships are not built. If they were built, we have not war vessels enough to give them safe convoy, or coal enough available to propel them.

How about food, clothing, arms and ammunition? How about machine guns, heavy artillery, shells, trucks, etc.? The truth is that the United States wasted three years of valuable time in criminal slothfulness, while France and England were shedding their best blood in our defense.

If Germany shall win or if Germany shall dictate terms of peace, the sin of omission chargeable to us will forever remain a blot on the good faith, the intelligence, the honor and the civilization of the United States.

Our lack of preparedness was not a blunder; it was a crime. Foresighted men uttered appeal after appeal. The logic of events abroad unmistakably indicated that the United States would be forced to take a hand in the struggle. Patriotic men, who had clear vision and a sense of responsibility, implored the government to prepare for the inevitable. Every effort was made to rouse the public, but without avail. Doped into lethargy by indifference, steeped in the self-complacent idea that America with bare hands could whip the world, and recreant to their duty to mankind, the American people deliberately refused to give heed to the warning given them at home and from abroad.

The government and the people now realize that their short-sightedness was stupid and that their indifference was morally culpable. But a lesson is not learned until it is thoroughly learned. The country is still living in a fool's paradise of fatuity. It sees but one side of the matter.

War is upon us. There are men enough available, although it takes months to fit them for service. The problem of supplies is vast and complex. Enormous quantities of food are needed. The only thing thought of so far as a means of solving the problem is conservation, intensified farming and relieving railroad congestion.

Of what avail is it to raise more crops and to save food if they cannot be quickly collected and distributed? The government statisticians estimate that more than $19,000,000,000 worth of farm products were raised in the United States in 1917. Every pound of this vast supply must be hauled over rural roads. There are more than 12,000,000

farm workers on more than 6,000,000 farms in 30,000 townships in 48 states.

About 2,400,000 miles of roads connect these farms with markets. Only about 10 per cent. of this mileage has ever been "improved," and only about 5 per cent. of the mileage really is improved. A map of these improved roads—for the most part short stretches with unimproved sections between, and, generally speaking, little attempt made to build through highways—would resemble an enlarged microscopic view of a group of tuberculosis bacilli.

The futility of such sporadic road-building ought to be obvious even to the wayfaring man. The penny-wise policy of saving at the good-roads spigot while allowing enormous waste at the bunghole of inaccessible products, is an indictment of the intelligence of the American public.

Mobility is imperatively necessary in war times; it will be the determining factor in the issue joined between savagery and civilization.

Swift movement of supplies, from productive points to areas of consumption, is impossible unless adequate lines of transportation are open at all times. A bad stretch of road lays an embargo upon traffic over the whole line. Ninety-five per cent. of unimproved, or unsuitably improved, highways amounts to an enforced suspension of transportation for a considerable period every year, and reduces to the minimum effective rural transportation of foodstuffs and supplies.

In view of these incontestible facts, suspension, or even material curtailment, of road building would be disastrous.

Some of the broad-minded Cabinet officers, as well as such military commanders as Gen. Leonard Wood, Gen. George W. Goethals and Gen. W. H. Black, Chief of Engineers, U. S. A., are strenuously urging active road building on a comprehensive, nation-broad scale, as an economic and military necessity.

Brig. Gen. E. Eveleth Winslow Has Some Very Strange Illusions

Brig. Gen. E. Eveleth Winslow, Engineer Corps, U. S. A., War Department, Washington, D. C., in a 2,000-word letter to *Manufacturers Record*, Baltimore, takes occasion to demonstrate how limited the vision of man in high position can be.

General Winslow writes about road building, and the substance of his lengthy and obviously labored communication is that highways are chiefly valuable for local use; that railways are adequate for all long-distance traffic except at certain times; that "relief from existing conditions is not exactly a military necessity, for the present congestion of rail traffic is interfering not to any material extent with military business, but rather with commercial business;" that present discussion of the importance of improved highways for long-distance traffic has been selfishly stimulated by people who are interested in the production of automobile trucks.

These deliverances would be sufficiently remarkable if coming from a back-district oracle, but when they are gravely put forth by a high commissioned officer in the Engineering Corps of the United States Army they suggest an explanation of some of the hitherto inexplicable doings at Washington.

General Winslow's conception of military operations as an abstraction wholly disconnected with the progress of business affairs certainly is amazing. How military success can be achieved independently of commercial resources may be clear to General Winslow, but he is entitled to the dis-

Highways *hard*-surfaced with "Metropolitan" or "Bessemer" Block withstand the smashing shocks and gruelling grind imposed by heavy truck transports in the first inter-city and inter-state haulage of freight and munitions. Military Highways can be ***more speedily*** and ***most economically*** constructed of "Metropolitan" and "Bessemer"—and they will be ***dependable.***

Repressed and Wire-Cut Lug

THE METROPOLITAN PAVING BRICK CO.

"The World's Largest"

CANTON, OHIO

tinction of being the original discoverer and sole possessor of the idea. The layman has always supposed that there was an intimate relationship between commercial and industrial prosperity and the success of war; and the idea that the transportation of supplies is a military necessity has been quite prevalent.

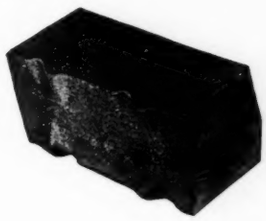
Interruption of business, congestion of traffic, which lays an embargo upon the transaction of business, obviously hamper the collection and distribution of supplies which always move in commercial channels and by means of the mechanism of the commercial system.

General Winslow cannot see that relief of existing conditions and uninterrupted flow of supplies for military purposes and of commodities and materials essential to business activity are a military necessity; but even a soap-box strategist ought to know that military operations are dependent upon the interests which produce and handle foodstuffs and munitions. There can be no military success without the transportation which assures collection and distribution of the products without which armies cannot live or without which armies cannot operate successfully.

The great bulk of supplies comes from farms, and in the first instance all these products must be transported over 2,400,000 miles of highways, only 10 per cent. of which are in any way improved. In 1917 the value of these products was $19,500,000,000.

The loss of time and money incurred in hauling this enormous volume of products over unimproved roads to railways is incalculable. Such transportation is slow, laborious and costly. Improved highways would cheapen transportation and it would increase the effectiveness of horse motive power at least 400 per cent.

Robbins — Coaldale — Graves



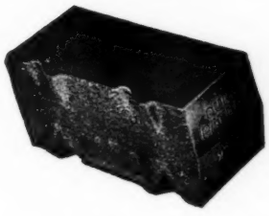
Wire-Cut Lug Brick

When you lay *Wire-Cut Lug Brick* streets or roads, you can spend your maintenance fund in getting new mileage, not tinkering the old.

Southern Clay Mfg. Co.

CHATTANOOGA, TENN.

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

MEDAL BLOCK
"The Block with Experience behind it"
BUYING cheap goods to save money, is like stopping the clock to save time; and this applies to many types of road surfacing material. If you want the only sure, durable and reliable road surface, buy
23 YEARS SERVICE
MEDAL BLOCK
"The Block with experience behind it"
Manufacturers of Medal Block for 23 years.
Manufacturers of Paving Brick for 29 years.
Oldest in service unexcelled in quality.
Medal Repressed, Wire-Cut-Lug and Hillside Block.
Capacity 55,000,000 annually.
THE MEDAL PAVING BRICK COMPANY
FORMERLY THE DECKMAN-DUTY BRICK CO.
1305-1308 Swetland Building
Cleveland, Ohio

Back to Brick

The Brick to Back

For smooth (but not slippery), sanitary and durable pavements, build of **Wire-Cut Lug Brick,** either monolithic or semi-monolithic type of design.

Wire-Cut Lug Brick pavements are non-abrasive. They are impervious to the elements and to oils and acids.

No kind of traffic causes them to rut, pit, disintegrate or become wavy. Maintenance and repairs are negligible for many years.

Suitable for any kind of filler commonly used with any brick.

Specified Exclusively for Brick Pavements

by scores of cities; used almost exclusively by several State Highway Departments for brick highways.

Made by 47 independent, competing companies operating 71 plants in 12 states.

COMPANIES PRODUCING WIRE-CUT LUG BRICK.

—LICENSEES—

Corry Brick and Tile Co., Corry, Pa.
United Brick Co., Greensburg, Pa.
Sterling Brick Co., Olean, N. Y.
Danville Brick Co., Danville, Ill.
Clinton Paving Brick Co., Clinton, Ind.
Alton Brick Co., Alton, Ill.
The Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
Peebles Paving Brick Co., Portsmouth, Ohio.
Murphysboro Pav. Brick Co., Murphysboro, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
McAvoy Vitrified Brick Co., Philadelphia, Pa.
Windsor Brick Co., Akron, Ohio,
Hocking Valley Brick Co., Columbus, Ohio.
Veedersburg Paver Co., Veedersburg, Ind.
Springfield Paving Brick Co., Springfield, Ill.
Terre Haute Vitrified Brick Co., Terre Haute, Ind.
Albion Vitrified Brick Co., Albion, Ill.
Alliance Clay Product Co., Alliance, Ohio.
Westport Paving Brick Co., Baltimore, Md.
Mack Mfg. Co., New Cumberland, W. Va.
Hydraulic-Press Brick Co., St. Louis, Mo.
Barr Clay Company, Streator, Ill.
Thornton Fire Brick Co., Clarksburg, W. Va.
Indiana Paving Brick & Block Co., Brazil, Ind.
Standard Brick Co., Crawfordsville, Ind.
Shawmut Paving Brick Works, Shawmut, Pa.
Pennsylvania Clay Co., Pittsburgh, Pa.
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The John Kline Brick Co., Wickliffe, Ohio.
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F. R. Carter, Peoria, Ill.
C. P. Mayer Brick Co., Bridgeville, Pa.
Athens Brick Co., Athens, Ohio.
Albion Shale Brick Co., Albion, Ill.
Copeland-Inglis Shale Brick Co., Birmingham, Ala.
Brick, Terra Cotta and Tile Co.; Corning, N. Y.
Medora Shale Brick Co., Medora, Ind.
Binghamton Brick Co., Inc., Binghamton, N. Y.
Municipal Shale Br'k & Bl'k Co., Martinsb'g, W.Va.
Lake Shore Shale Brick Co., Ashtabula, Ohio.
Allegany Valley Brick Co., Olean, N. Y.

Write for data.

THE DUNN WIRE-CUT LUG BRICK CO., Conneaut, Ohio.

(LICENSORS)

The Highway Economist

VOL. III. APRIL, 1918. No. 11.

AN ASPECT OF WAR OF VAST IMPORTANCE

The American eagle is a noble bird, and its warlike scream is supposed to strike terror to the stoutest-hearted foe. But the actual conflict is won by beak and talons.

The American eagle has but one head, while the Prussian eagle is double-headed. In a screaming contest, therefore, the American eagle is at a disadvantage.

Neither will making faces at the Kaiser win the war. Seen at a distance of 4,000 miles, a threatening face has no terrifying effect. Moreover, hiding in a cyclone cellar and crying "Peace!" will not induce the Kaiser to forego his designs of world sovereignty.

The rights of man and the fate of Christian civilization are being submitted to bloody arbitrament. The decision doubtless will favor the strongest battalions and the heaviest artillery. Faith is a beautiful thing. It sustains hope. But modern warfare is scientific. Results can be calculated with great accuracy if the terms of the problem are known.

So far the preponderance of effective men and of munitions and of science has been with Germany. With Germany war is almost an exact science. Very little is left to chance. Every movement is calculated and all movements are coordinated.

Germany seems surely to be wearing away the rock of resistance represented by the Allies. In men and resources and stamina the Allies are failing. The breaking point may be near. It may be reached this coming spring. The whole world is looking to the United States to save the day. *Will our aid arrive in time?* Everybody is asking the question. At the end of each month the question is asked less hopefully.

Events are fast crowding toward the supreme crisis. Germany, relieved on the east, is summoning all her resources in the hope of sweeping before her all resistance on the western front, by sheer weight of numbers.

The blow may fall before we can put in the field enough men to strengthen the Allies materially. Will the Allies be able to withstand the tremendous and persistent onslaught? So far as the Allies are concerned, the issue hinges on the throw of dice, rather than upon rational expectation of defensive strength.

How many effective men have we in France? The public does not know; but in view of the number of men still in camps and cantonments in this country, the public knows that the force in France must be pitifully inadequate for decisive action.

At the present rate of progress, it will require at least two years to equip and transport a million men, with their equipment and the guns and munitions required to make them efficient. Nearly everybody believes that it will take three million American soldiers to win the war; but unless these soldiers get into the game soon, the opportunity to win the war may pass.

Nearly one year has elapsed since the United States declared war, yet not a half million men are ready to be sent abroad. Probably not more than 200,000 men are suitably equipped and drilled. This estimate is, of course, no more than a reasonable conjecture.

Transportation facilities are notoriously inadequate. If we had a large army, we could not get it across the water within a year. It would require 400 transports, carrying 2,500 men each, to transport 1,000,000 men, and additional ships for carrying guns, food and munitions would be required. The ships are not built. If they were built, we have not war vessels enough to give them safe convoy, or coal enough available to propel them.

How about food, clothing, arms and ammunition? How about machine guns, heavy artillery, shells, trucks, etc.? The truth is that the United States wasted three years of valuable time in criminal slothfulness, while France and England were shedding their best blood in our defense.

If Germany shall win or if Germany shall dictate terms of peace, the sin of omission chargeable to us will forever remain a blot on the good faith, the intelligence, the honor and the civilization of the United States.

Our lack of preparedness was not a blunder; it was a crime. Foresighted men uttered appeal after appeal. The logic of events abroad unmistakably indicated that the United States would be forced to take a hand in the struggle. Patriotic men, who had clear vision and a sense of responsibility, implored the government to prepare for the inevitable. Every effort was made to rouse the public, but without avail. Doped into lethargy by indifference, steeped in the self-complacent idea that America with bare hands could whip the world, and recreant to their duty to mankind, the American people deliberately refused to give heed to the warning given them at home and from abroad.

The government and the people now realize that their short-sightedness was stupid and that their indifference was morally culpable. But a lesson is not learned until it is thoroughly learned. The country is still living in a fool's paradise of fatuity. It sees but one side of the matter.

War is upon us. There are men enough available, although it takes months to fit them for service. The problem of supplies is vast and complex. Enormous quantities of food are needed. The only thing thought of so far as a means of solving the problem is conservation, intensified farming and relieving railroad congestion.

Of what avail is it to raise more crops and to save food if they cannot be quickly collected and distributed? The government statisticians estimate that more than $19,000,000,000 worth of farm products were raised in the United States in 1917. Every pound of this vast supply must be hauled over rural roads. There are more than 12,000,000

farm workers on more than 6,000,000 farms in 30,000 townships in 48 states.

About 2,400,000 miles of roads connect these farms with markets. Only about 10 per cent. of this mileage has ever been "improved," and only about 5 per cent. of the mileage really is improved. A map of these improved roads—for the most part short stretches with unimproved sections between, and, generally speaking, little attempt made to build through highways—would resemble an enlarged microscopic view of a group of tuberculosis bacilli.

The futility of such sporadic road-building ought to be obvious even to the wayfaring man. The penny-wise policy of saving at the good-roads spigot while allowing enormous waste at the bunghole of inaccessible products, is an indictment of the intelligence of the American public.

Mobility is imperatively necessary in war times; it will be the determining factor in the issue joined between savagery and civilization.

Swift movement of supplies, from productive points to areas of consumption, is impossible unless adequate lines of transportation are open at all times. A bad stretch of road lays an embargo upon traffic over the whole line. Ninety-five per cent. of unimproved, or unsuitably improved, highways amounts to an enforced suspension of transportation for a considerable period every year, and reduces to the minimum effective rural transportation of foodstuffs and supplies.

In view of these incontestible facts, suspension, or even material curtailment, of road building would be disastrous.

Some of the broad-minded Cabinet officers, as well as such military commanders as Gen. Leonard Wood, Gen. George W. Goethals and Gen. W. H. Black, Chief of Engineers, U. S. A., are strenuously urging active road building on a comprehensive, nation-broad scale, as an economic and military necessity.

Brig. Gen. E. Eveleth Winslow Has Some Very Strange Illusions

Brig. Gen. E. Eveleth Winslow, Engineer Corps, U. S. A., War Department, Washington, D. C., in a 2,000-word letter to *Manufacturers Record*, Baltimore, takes occasion to demonstrate how limited the vision of man in high position can be.

General Winslow writes about road building, and the substance of his lengthy and obviously labored communication is that highways are chiefly valuable for local use; that railways are adequate for all long-distance traffic except at certain times; that "relief from existing conditions is not exactly a military necessity, for the present congestion of rail traffic is interfering not to any material extent with military business, but rather with commercial business;" that present discussion of the importance of improved highways for long-distance traffic has been selfishly stimulated by people who are interested in the production of automobile trucks.

These deliverances would be sufficiently remarkable if coming from a back-district oracle, but when they are gravely put forth by a high commissioned officer in the Engineering Corps of the United States Army they suggest an explanation of some of the hitherto inexplicable doings at Washington.

General Winslow's conception of military operations as an abstraction wholly disconnected with the progress of business affairs certainly is amazing. How military success can be achieved independently of commercial resources may be clear to General Winslow, but he is entitled to the dis-

Highways *hard*-surfaced with "Metropolitan" or "Bessemer" Block withstand the smashing shocks and gruelling grind imposed by heavy truck transports in the first inter-city and inter-state haulage of freight and munitions. Military Highways can be ***more speedily*** and ***most economically*** constructed of "Metropolitan" and "Bessemer"—and they will be ***dependable.***

Repressed and Wire-Cut Lug

THE METROPOLITAN PAVING BRICK CO.

"The World's Largest"

CANTON, OHIO

tinction of being the original discoverer and sole possessor of the idea. The layman has always supposed that there was an intimate relationship between commercial and industrial prosperity and the success of war; and the idea that the transportation of supplies is a military necessity has been quite prevalent.

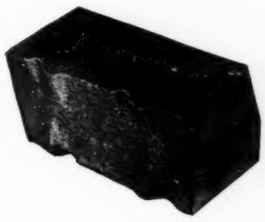
Interruption of business, congestion of traffic, which lays an embargo upon the transaction of business, obviously hamper the collection and distribution of supplies which always move in commercial channels and by means of the mechanism of the commercial system.

General Winslow cannot see that relief of existing conditions and uninterrupted flow of supplies for military purposes and of commodities and materials essential to business activity are a military necessity; but even a soap-box strategist ought to know that military operations are dependent upon the interests which produce and handle foodstuffs and munitions. There can be no military success without the transportation which assures collection and distribution of the products without which armies cannot live or without which armies cannot operate successfully.

The great bulk of supplies comes from farms, and in the first instance all these products must be transported over 2,400,000 miles of highways, only 10 per cent. of which are in any way improved. In 1917 the value of these products was $19,500,000,000.

The loss of time and money incurred in hauling this enormous volume of products over unimproved roads to railways is incalculable. Such transportation is slow, laborious and costly. Improved highways would cheapen transportation and it would increase the effectiveness of horse motive power at least 400 per cent.

Robbins — Coaldale — Graves



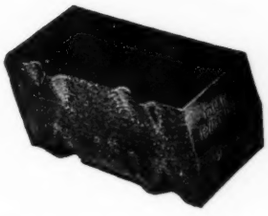
Wire-Cut Lug Brick

When you lay *Wire-Cut Lug Brick* streets or roads, you can spend your maintenance fund in getting new mileage, not tinkering the old.

Southern Clay Mfg. Co.

CHATTANOOGA, TENN.

Springfield Wire-Cut Lug



IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

MEDAL BLOCK
"The Block with Experience behind it"
BUYING cheap goods to save money, is like stopping the clock to save time; and this applies to many types of road surfacing material. If you want the only sure, durable and reliable road surface, buy
MEDAL BLOCK
"The Block with experience behind it"
Manufacturers of Medal Block for 23 years.
Manufacturers of Paving Brick for 29 years.
Oldest in service unexcelled in quality.
Medal Repressed, Wire-Cut-Lug and Hillside Block.
23 YEARS SERVICE
MEDAL BLOCK
Capacity 55,000,000 annually
THE MEDAL PAVING BRICK COMPANY
FORMERLY THE DECKMAN-DUTY BRICK CO.
1305-1308 Swetland Building
Cleveland, Ohio

Back to Brick

The Brick to Back

For smooth (but not slippery), sanitary and durable pavements, build of **Wire-Cut Lug Brick,** either monolithic or semi-monolithic type of design.

Wire-Cut Lug Brick pavements are non-abrasive. They are impervious to the elements and to oils and acids.

No kind of traffic causes them to rut, pit, disintegrate or become wavy. Maintenance and repairs are negligible for many years.

Suitable for any kind of filler commonly used with any brick.

Specified Exclusively for Brick Pavements

by scores of cities; used almost exclusively by several State Highway Departments for brick highways.

Made by 47 independent, competing companies operating 71 plants in 12 states.

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Allegany Valley Brick Co., Olean, N. Y.

Write for data.

THE DUNN WIRE-CUT LUG BRICK CO., Conneaut, Ohio.

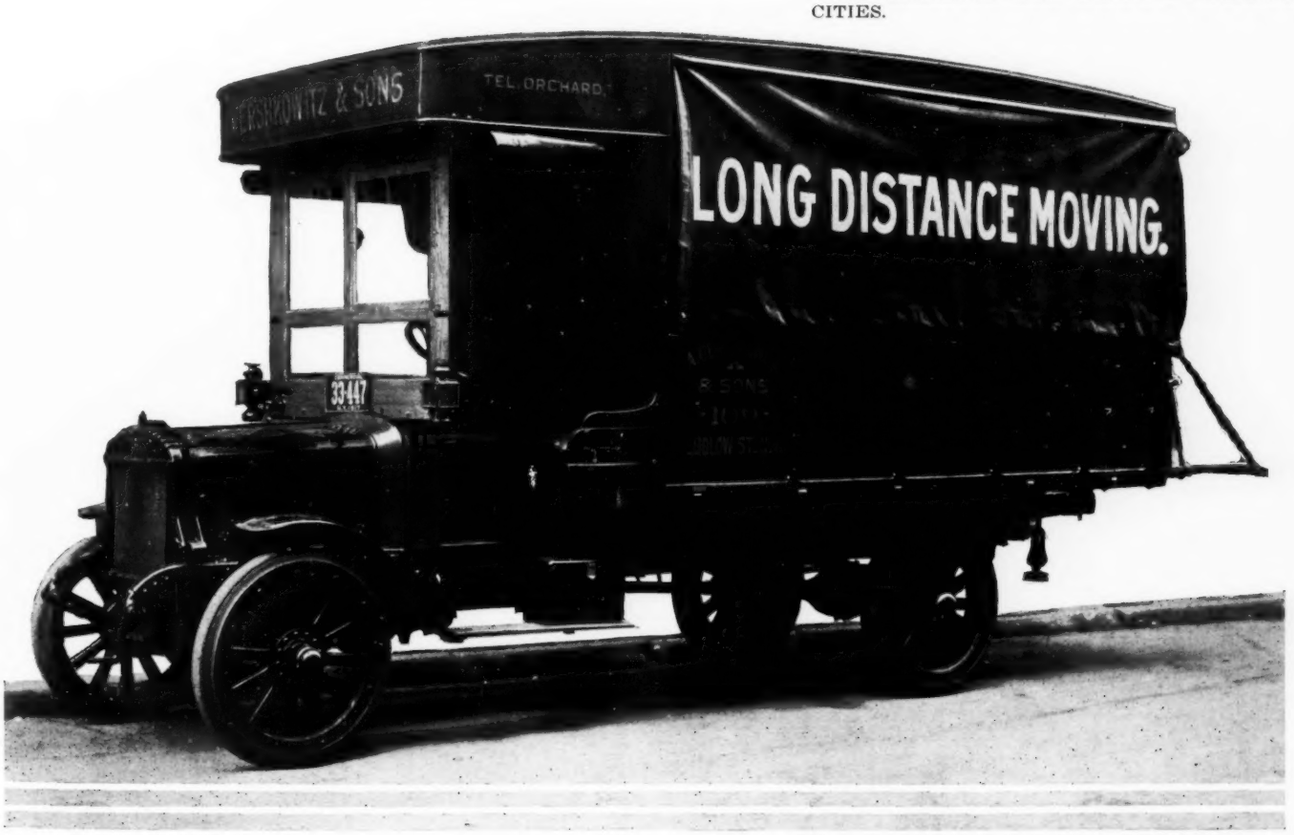
(LICENSORS)

MOTOR TRUCKS

Motor Trucks as Operated in the Intercity and Interstate Haulage of Freight on the Highways.

(THIRD INSTALLMENT)

MASTER 2-TON TRUCK AS OPERATED BY A. GERSHKOWITZ & SONS, NEW YORK CITY, IN THE LONG DISTANCE HAULAGE OF FREIGHT BETWEEN NEW YORK CITY AND MASSACHUSETTS AND RHODE ISLAND CITIES.



Printed as insert to Municipal Engineering, April, 1918.

Mack
TRUCKS

MACK COMPETENCY

By constant, day-after-day service through all seasons of the year, MACK trucks prove their remarkable stamina and their wonderful reliability. Speed on ordinary roads, power on hard, steep climbs, economy through great haulage ability—these are facts that make the MACK a most efficient and competent truck.

Operated from the seat, the powerful MACK hoist raises the body to an angle of 40°—from this pitch any load slides off readily. Dumping is quick and easy. This speed in unloading makes more hauls possible, and lessens the cost per ton mile. The hoist is but one of many paying features that MACK engineering skill has adopted for practical use.

Write for MACK performances in your line of business.

MACK trucks are made in sizes from 1 to 7½ tons capacity; with trailers, up to 15 tons. Special bodies can be designed to meet specific needs.

INTERNATIONAL MOTOR COMPANY
NEW YORK

Performance Counts

Ship via Highways!

The Solutions of *Your* Problems

The fate of nations and of your business depends upon the speed with which this country can transport tonnage at home and abroad.

Don't throw up your hands in despair because of the freight car shortage. Don't abuse the railroads—help them and yourselves by using Garford Motor Trucks.

Ship via the Highway—Garford route!

Confine all short haul and intercity shipments to motor trucks and let the railroads handle the cross-country-freight. That is the solution of the transportation problem.

Thousands of merchants have already adopted this plan. Many more thousands will be using motor trucks in the near future.

You can do "business as usual" with the help of Garford Motor Trucks. Let our traffic experts show you how.

In writing us address Dept. 107.

Garford MOTOR TRUCKS

The Garford Motor Truck Company, Lima, Ohio

Manufacturers of Motor Trucks of 1, 1½, 2, 3½, 5 and 6 ton capacity. 4½, 7 and 10 ton Tractors
The Garford Road Builder

GMC
TRUCKS

For Chicago Engineering Work

When the Engineering division of the Chicago Department of Public Works wanted a ton-and-a half truck for rough and ready service in the country's second city, a GMC was selected.

Chicago had amply tested the merits of GMC construction in trucking work of a similar nature. GMC service had been found equal in every respect to factory thoroughness in building trucks; and then there was the prestige and promise of a great and stable organization—the backing of the General Motors Corporation.

From the early times of truck building, GMC Trucks have developed with the progress of the years. GMC Trucks are made in a factory where truck building has been the sole industry. Today there is embodied in the product every good thing known to truck making.

One of the big things in construction is GMC oversize and overstrength, imparted to every vital point in the mechanical plan of every GMC Truck. It is the GMC way.

GMC Trucks are made in six practical sizes, each better fitted than any other for a particular class of work.

Let Your Next Truck be a GMC.

GENERAL MOTORS TRUCK COMPANY

One of the Units of the General Motors Corporation

New York Philadelphia Boston **PONTIAC, MICH.** Chicago St. Louis San Francisco

Distributors most Everywhere

(326)

Motor Truck Operation and Accounting XXXII.

By Charles A. Dickens

(*Continued from March Issue*)

Truck Service for Three Years Between Albany and Gloversville, N. Y.

A number of express routes had been in successful operation for several years before the railroads became so congested that it was necessary to adopt the motor truck for intercity haulage. A. F. Kromp, a Schenectady expressman, for the last three years has operated a regular route between Albany, Schenectady, Amsterdam, Johnstown and Gloversville. He operates a fleet of three 2½-ton Mack trucks. The principal commodity carried is foodstuffs for a large line of chain stores, the main distributing centre being in Schenectady. From this central point, retail stores in the adjacent cities and towns are supplied.

These three trucks average over 100 miles apiece each day. The oldest truck has covered over 60,000 miles. An accurate record of the cost of operation is kept. Mr. Kromp says the 2½-ton Macks average 9 to 10 miles to the gallon of gasoline and 450 miles to the gallon of oil. They are geared to make 20 miles an hour and have proven a very profitable investment.

Delivering Heavy Trailers Overland, Detroit to Pittsburgh

The Fruehauf Trailer Co., of Detroit, recently completed two 10-ton semi-trailers which were attached to Acason tractors and driven to Pittsburgh during most adverse weather conditions. The units are to be used by Scriber & Morrow, of Coal Valley, Pa., in hauling coal from a mine near Pittsburgh.

Each trailer is equipped with a 10-ton Wood hydraulic hoist. The bodies of the trailers, which are 7 ft. wide, 12 ft. long and 4 ft. high, are all-steel lined and were built especially to handle coal.

"These large semi-trailers are particularly adaptable to coal handling and will decrease haulage costs over one-half," said H. C. Fruehauf, general manager of the Fruehauf Trailer Co. "The trailers can be hauled easily by 3½-ton trucks and thus treble the capacity of the hauling unit. We have clearly demonstrated that Fruehauf trailers will cut transportation costs from 50 to 200 per cent. in the coal business, and save time as well, which is a most important factor."

Some Miscellaneous Examples of Intercity and Interstate Trucking

In order to do business despite the freight embargo in the New England states, lighting fixtures and mantles were shipped by motor truck from New Jersey to New England and talking machines from Philadelphia to Providence, a distance of 274 miles. A Buffalo firm engaged in carrying anything by motor truck has adopted the slogan: "Anywhere within a radius of 200 miles."

To meet an advanced sailing date a Philadelphia chemical manufacturer was confronted with the necessity of delivering 6 tons of antitoxin to a South Brooklyn wharf within 24 hours or suffer cancellation of his contract. The railroad freight agent laughed at the idea of reaching South Brooklyn in 24 hours with a 6-ton freight shipment. The express companies refused to guarantee delivery on time. A 6-ton motor truck was engaged and the load delivered at the dock 5 hours before sailing time. The truck delivered the goods at $4.86 per ton. The railroad freight rate was $6.80, with the derisive laughter of the freight agent gratuitously included, and the rate of the polite but helpless express company was $18. The chemical manufacturer has since bought several trucks and makes shipments twice a week to New York.

Nash Trucks in Intercity Haulage

L. A. Cox & Son, merchants, Purdum, Neb., have a Nash Quad, on which they haul general merchandise, oils, hardware and agricultural implements. They have a haul of 13 miles to and 13 miles back from the railroad. They make the trip about twice a week and haul from 3,000 to 4,500 lbs. at a trip. They operate through snowdrifts and stretches of sand with equally good results. They say the Quad will take its load anywhere it can get traction.

Emery W. Smith, of Cheshire, Conn., uses a Nash Rapid Service truck in delivering apples to New Haven. He says it never refuses to go through mud or snowdrifts, and carries from 12 to 15 barrels per load. After running this truck 3,500 miles it was in as good trim as when purchased.

R. B. Howard, of Winner, S. Dak., has a Nash Quad equipped with a 500-gal. tank, which he uses on country roads in delivering oil and gas to big tractors and small inland towns. In the first 10 months he owned this truck he drove it 6,000 miles. During that time he spent $75 on the truck, in part for overhauling and cleaning the engine. On the very bad roads traversed this truck takes the place of eight horses,

GARFORD TRUCK HAULING A CONCRETE MOTOR BOAT FROM CHICAGO TO NEW YORK DURING RECENT COLD WEATHER.

Service-Ability Means Road-Ability

Hard Driven—Overloaded—plowing along in deep, clinging mud and sand—Service Trucks are winning the *hardest* jobs. Their *oversize* construction, backed by their *super* power, means "Road-Ability"—that rare quality that enables you to "get there," no matter the load or the "going."

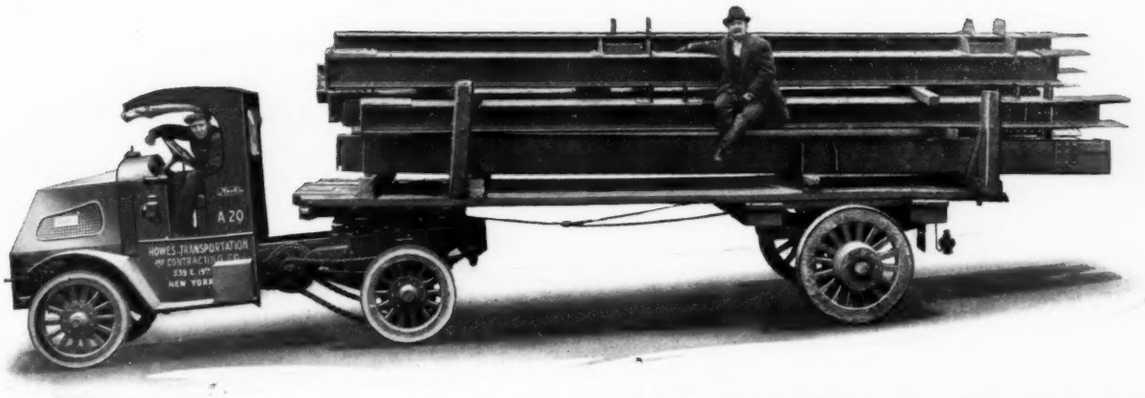
Service Trucks not only contain the *best* bronze bearings and bushings, incomparable axles and brakes, but many structured innovations unknown to trucks priced considerably higher.

Service Trucks not only have greater loading length but extra deep and extra heavy steel frames with wider flanges.

Service Trucks are 20% stronger and develop 11% greater power than any truck made by the "Dominant Seven." The Service Truck is more than a mere truck. It is a truck of **obvious** values. Its *extra* values are as clear and definite as daylight.

Service Motor Truck Co.

WABASH, INDIANA.



MACK TRACTOR WITH FIFTH WHEEL CONNECTION OPERATED IN CONJUNCTION WITH TRAILER BY HOWIS TRANSPORTATION AND CONTRACTING CO., NEW YORK CITY, IN HAULING STRUCTURAL STEEL.

and one driver is dispensed with also. He has made as high as 120 miles in a 12-hour day and unloaded three loads. The average cost of running the truck on fair roads is 1½ cts. per mile, not including driver's wages, and figuring gas and oil at the prevailing high prices in that locality.

The St. Croix Lumber and Manufacturing Co., of Winston, Minn., use a Nash Quad in hauling supplies from Ely to their headquarters camp, their distribution center, a distance of 26 miles from Ely. They figure the cost of delivering a 2-ton load of supplies to headquarters camp and returning empty, a round-trip distance of 52 miles, as follows:

Gasoline, 22 gal. at 13c	$2.86
Polarine Oil, 2 qts. at 10c	.20
Chauffeur, 1 day at $75 per month	2.89
Helper, 1 day at $26 per month	1.00
Board, two men for 2 days at 50c per day	1.00
Total	$7.95

This represents practically a cost of 20 cts. per hundred weight, the round trip consuming one day. The roads are so rough and the hills so steep and crooked that the trailer cannot be used, so the average load does not exceed 2 tons. Under fair conditions the trailer could be used and the load thereby increased to 3 or possibly 4 tons, instead of 2 tons, which would naturally materially reduce the cost of hauling.

The Anchor Webbing Co., of Woonsocket, R. I., operated a ¾-ton Nash truck right through a recent winter between Providence, Pawtucket and Woonsocket. During this time there were many heavy snow-storms and very bad roads, but the truck stood up to its work well with very little expense for repairs.

When C. E. Garner, of 416 So. State St., Los Angeles, decided that shipping cattle by railroads was too slow, likewise somewhat expensive, he cast his lot with the motor truck. His experiment proved a success from the start. It is not an unusual feat for Garner to transport five head of cattle in his Nash 1-ton truck from Los Angeles to Antelope Valley. It is a great improvement over the old system, whereby cattle had to be driven slowly for distances ranging from 10 to 25 miles to the railroad, where, after the usual wait, they were loaded into cars and then transported to a point nearest the place where they were to be quartered.

Garford Truck on Novel Trip

During the recent cold weather fully 50 per cent. of locomotive efficiency was nullified by low temperatures and every waterway North of the Ohio river was out of use altogether. During that time a Garford motor truck traveled from Chicago to New York, bearing as its load a concrete motor boat for the National Motor Boat Show. A sign carried on the truck read:

GOOD ROADS TO WIN
MOTOR TRUCKS WILL HELP
CONCRETE SHIPS THE WAR

Motor Freighting in the East

A manufacturing company located on the Hudson river has been obliged to send trucks to Buffalo, Cleveland, and even farther West during the past year to bring to the factory certain necessary materials that could not be brought by rail

MACK TRACTOR HAULING AN 11-TON MILK TRAILER, AS OPERATED BY SLAWSON DECKER CO., BETWEEN SHEFFIELD FARMS AND NEW YORK CITY. EACH TRACTOR OPERATES WITH FOUR TRAILERS.

The Hazel Atlas Glass Company

needed trucks—5-tonners that would give twenty-four hour continuous service. They inspected many—decided on the GRAMM-BERNSTEIN and are *satisfied.*

"Guaranteed for the life of the truck"—transmission, springs and radiator! The broadest guarantee given by any American manufacturer. Here's a warranty that sets a new standard of truck service. A positive assurance that your *first* cost will not be subordinate to continuous and extravagant repair bills.

Accurate and dependable operating cost data of Gramm-Bernstein Motor Trucks in over one hundred different lines of business now available. Write for it.

The GRAMM-BERNSTEIN MOTOR TRUCK CO.

Lima, Ohio.

FEDERAL 1½-TON TRUCK AND TYPE OF 8-HORSE TEAM WAGON IT DISPLACED IN INTERCITY MOUNTAIN HAUL OF 52 MILES, REDDING TO WEAVERVILLE, CALIFORNIA.

in time to prevent manufacturing delays. Motor trucks have frequently been used to haul loads from Hartford, Conn., and cities in Massachusetts to New York to insure catching ocean steamers before their sailing time.

It is part of the business of professional movers to haul vanloads of goods by motor truck between all of the Eastern cities. Trips of this kind between New York and Philadelphia are of daily occurrence, while removal from Boston to New York by motor truck can be arranged readily. The distance of about 250 miles is covered in two days—quicker than by rail and cheaper in the end, because the furniture does not need to be crated and only two handlings are necessary.

Freighting by motor between New York and Philadelphia has become a regular business. One firm of motor-trucking contractors operates a fleet of 22 5-ton trucks in daily service over this 90 mile route. It delivers by noon in each city all goods received up to five o'clock in the evening of the day before in the other city. It can handle more than 200 tons of freight daily over this route. In addition to this regular service, the company makes special trips to Wilmington, Baltimore, and Washington, Bethlehem, Reading, and Harrisburg, and to cities in the New England States.

Trucking 5-*Ton Load* 225 *Miles in* 22 *Hours*

Upton, Mass., is just 225 miles from New York City. A New York buyer telephoned W. G. Fiske of Upton a lumber order conditioned on delivery at the buyer's dock in 24 hours. The order was accepted and within an hour a Packard truck carrying a load of 11,500 lbs. was on the way to New York, arriving there 22 hours later. The return journey was made in 20 hours. On the round trip of 449 miles, 81 gals. of gasoline were consumed or an average of 5½ miles to the gallon. This record is remarkable considering the many hills and stretches of poor road which were encountered.

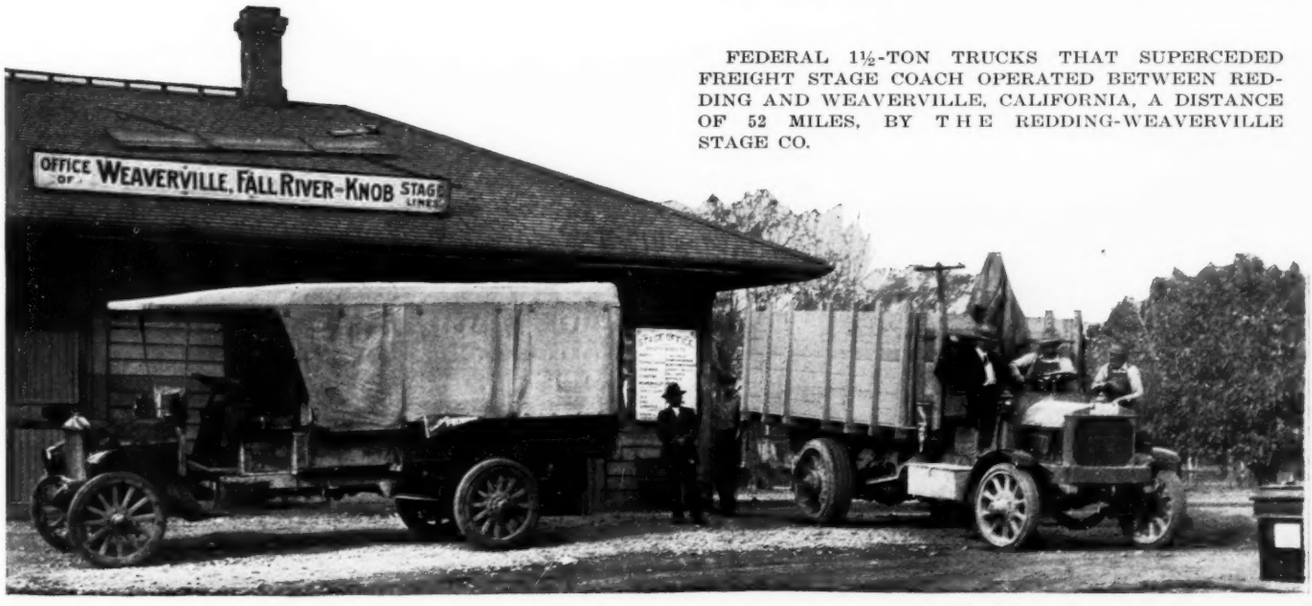
Duplex Hauls Load 391 *Miles in* 60 *Hours*

Dependability, one of the most important requirements of motor trucks for overland haulage of freight, was conclusively demonstrated to be a feature of the Duplex recently, when one of the 4-wheel drive trucks made a trip from the Duplex company's factory in Lansing to Pittsburgh in 60 hours actual running time. So successful was the trip from every standpoint that regular trips are to be made from the Michigan capital to the eastern city.

In order that accurate information might be obtained and the practicability of the Duplex for overland haulage work determined, the driver of the truck made a careful record of the trip. The total mileage was 391 and the total number of gallons of gasoline used was 59, or 6.6 miles per gallon. Five quarts of oil and one pint of water were required for the trip.

The truck left Lansing at 3 o'clock on a Monday afternoon and arrived in Pittsburgh the following Friday morning at 2 o'clock. The total cost of operation, including driver's wages and expenses, cost of gasoline and oil, and including depreciation, tires, insurance and maintenance, was $56.11.

The railroad freight rate between Lansing and Pittsburgh



FEDERAL 1½-TON TRUCKS THAT SUPERCEDED FREIGHT STAGE COACH OPERATED BETWEEN REDDING AND WEAVERVILLE, CALIFORNIA, A DISTANCE OF 52 MILES, BY THE REDDING-WEAVERVILLE STAGE CO.

The Seal of Dependable Service

ACME THE TRUCK OF PROVED UNITS

Trade Mark Reg. U. S. Pat. Off.

Saving Money on the Job
—That's the ACME Every Time

Whether the job is big or little—whether the haul is long or short—you can count on the economical **Acme** to handle it at a saving.

The **Acme** owner can underbid competition. He can figure his costs considerably under the other fellows'—and still make the same profit Let us submit facts and comparative figures which prove the claims we make.

The ACME Truck Cuts Haulage Costs

Scores of **Acme** users in municipal contracting report a net saving of 15 to 25 per cent in haulage costs.

Acme economy—**Acme** dependable performance—are assured by **Acme** *proved units.* Sixteen master manufacturers—each the acknowledged leader in his field—contribute **Acme** *proved units.*

Proved Units of the Acme

Continental Motor
Timken Worm-Drive
Timken Axles
Timken Bearings
Pierce Governor
Detroit Springs
Stewart Vacuum Feed
Hayes Artillery Type Wheels
Long Truck Type Radiator
Eisemann High Tension Magneto
Rayfield Carburetor
Ross Steering Gear
Cotta Transmission
Pressed Steel Frame
Blood Bros. Universal Joints
Borg & Beck Clutch

Continental Motor, Timken Axles, Timken Bearings, Timken Worm-Drive, Detroit Springs, Cotta Transmission, Pierce Governor, Pressed Steel Frame, and so on down the list.

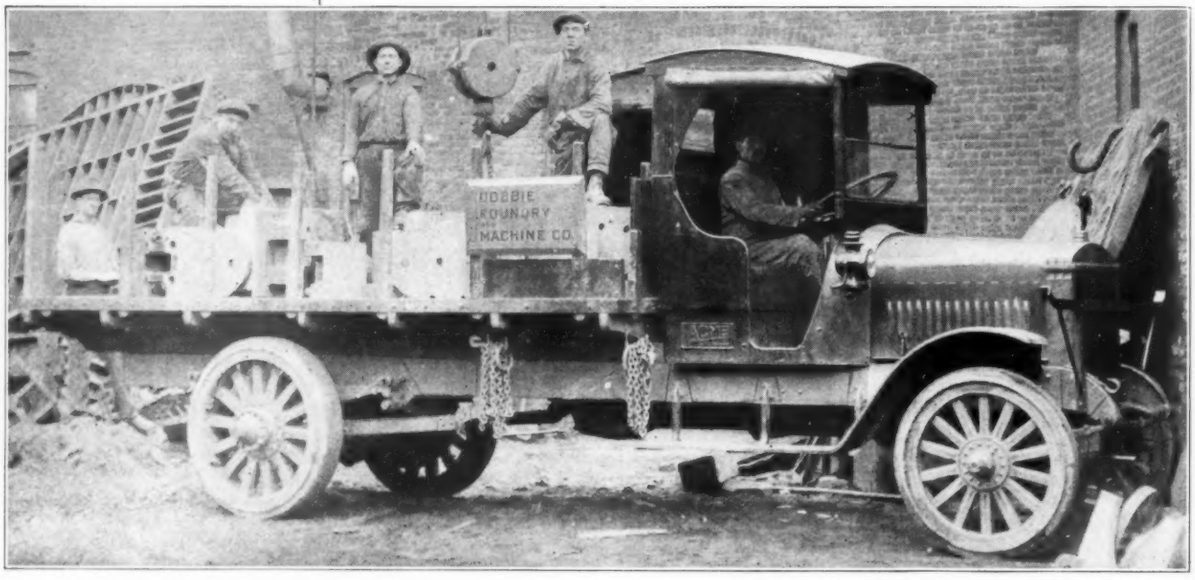
Now is the time to buy your **Acme.** You can get it without delay—if you place your order early. Why not begin at once *to add that 15 to 25 per cent savings* to the net profits of your business?

See the nearby **Acme** dealer—or write us. Send for the new **Acme** book—*"A Pointer to Profits"*—full of money-saving information.

Models—1 to 4 tons.

ACME MOTOR TRUCK COMPANY

157 Mitchell Street **CADILLAC, MICH.**



CLYDESDALE TRUCKS AS OPERATED BY THE WAVERLY AUTO EXPRESS CO., NEW YORK CITY, IN INTERCITY HAULAGE IN THE METROPOLITAN DISTRICT.

on 7,000 pounds, the truck's capacity, is $41.30, or $14.81 less than the cost of transporting 3½ tons of merchandise by Duplex truck.

However, the Duplex hauled its load of merchandise direct from the manufacturer's factory in Lansing to the business house of the purchaser in Pittsburgh, thus saving a cartage charge at both ends that would total several dollars.

"The 391-mile trip was made without accidents or mechanical trouble of any kind," said President H. M. Lee of the Duplex Truck Company. "The only delay occurred when the truck was held up 4½ hours by other trucks that were stuck in the mud between Cleveland and Pittsburgh.

"It was clearly demonstrated that the Duplex is absolutely dependable for overland transportation of freight and can successfully compete with the railroads on a basis of time of delivery as well as economy. The trip was truly a remarkable performance when it is considered that the truck left Lansing in a regular Michigan blizzard and hauled its load through eastern Ohio roads, hub deep with mud.

"The freight was delivered in Pittsburgh 3½ days after it left Lansing—several days in advance of the freight traffic schedule of railroads. This is a most important consideration with manufacturers—and many times a saving in time of 24 or 48 hours is worth more than the actual freight rate."

Federal Government's New Highway Transport Service Will Relieve 15,000 *Freight Cars*

The following statement was recently authorized by the Quartermaster General of the United States Army:

The first section of the American Army's new experimental truck transport service has started from Detroit on its way to the Atlantic seaboard. The trip is being taken in an effort to relieve congestion in freight terminals by the overland use of motor trucks. The plans have been worked out by the Quartermaster's Department and the Highways Transport Committee of the Council of National Defense.

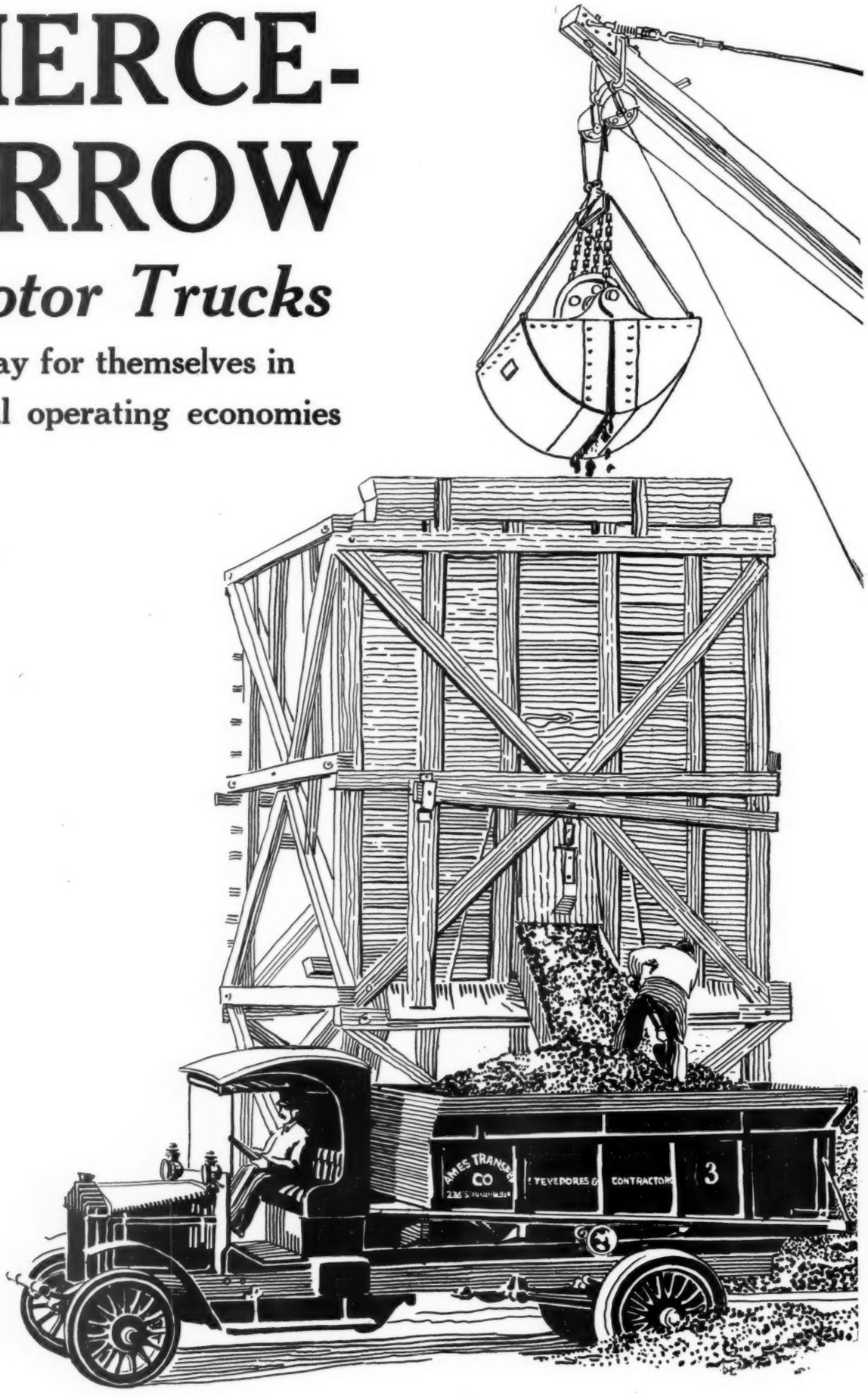
If the plan proves successful, it is estimated that the total relief to the railroads, through the shipment to the coast under their own power of the 30,000 war trucks the army has under construction, will amount to 690,000 tons. The trucks have an average capacity of three tons and only two of them can be

GENERAL MOTORS 3½-TON TRUCK AS OPERATED BY THE PITTMANS-DEAN CO. OF DETROIT FOR HAULING COAL AND ICE IN DETROIT AND SUBURBS.

PIERCE-ARROW

Motor Trucks

Pay for themselves in actual operating economies



YOU often hear truck salesmen say: "Motor trucks pay for themselves." You may set this down to bubbling enthusiasm, but here is a case in point:

The Ames Transfer Company of New York own twenty-eight Pierce-Arrow Trucks. They bought their first one in July, 1911—number 25 of the Pierce-Arrow output. It is still in service and has run over 100,000 miles.

They were then operating with forty mules and a variety of wagon equipment, but observing the saving in actual operating economy effected by the Pierce-Arrow truck they replaced their equipment with a fleet of ten Pierce-Arrows, and in about a year the fleet paid for itself.

Since then they have added steadily to the number of trucks in use until they now operate twenty-eight.

They principally transport cement, sand and gravel in excavating contracting and construction work, incident to large building operations such as the New York Subway, the Aqueduct and important railroad work.

In rush periods they have rented trucks of various other makes and subjected them to competitive tests and report that the Pierce-Arrow Trucks have invariably proved far more efficient and economical.

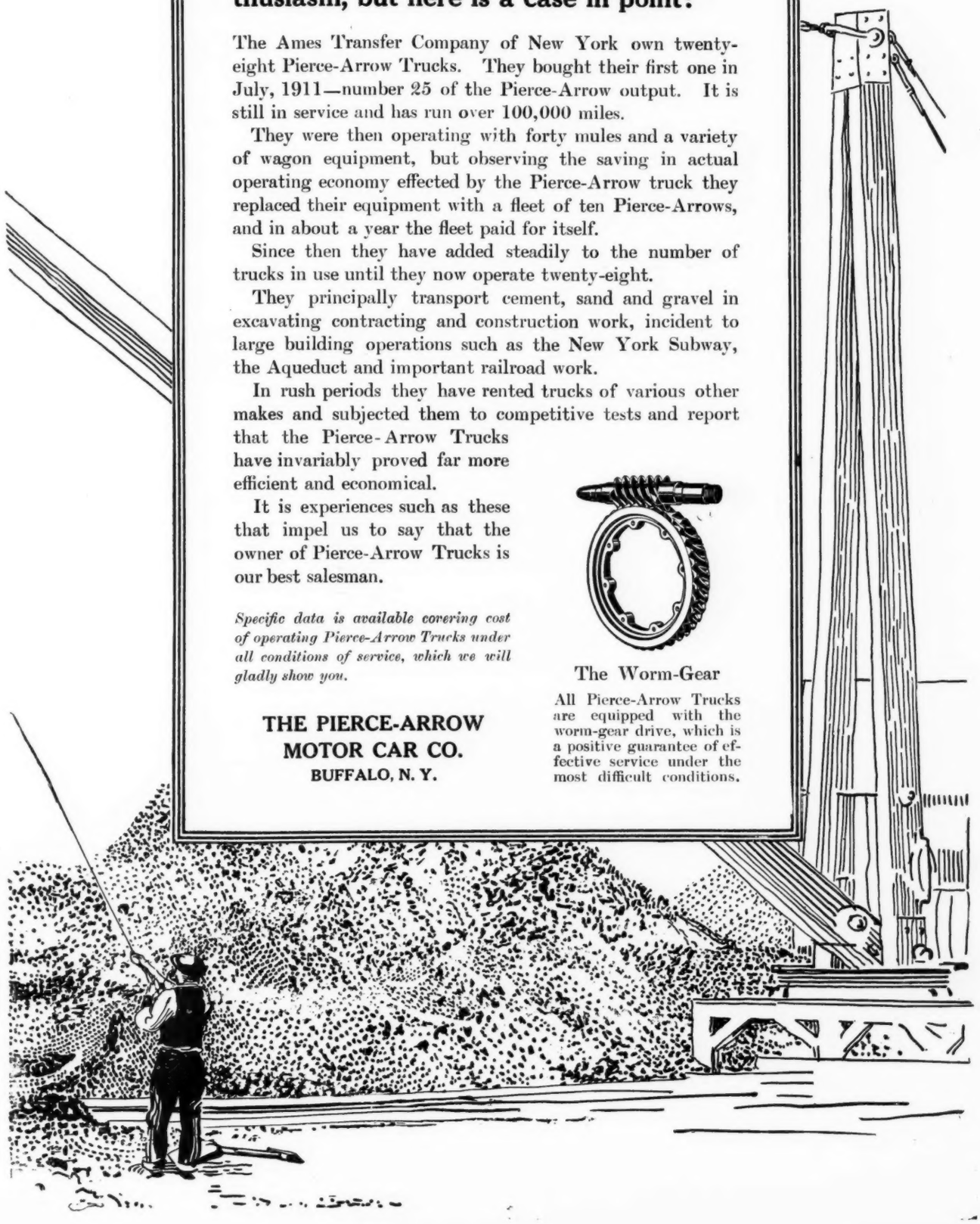
It is experiences such as these that impel us to say that the owner of Pierce-Arrow Trucks is our best salesman.

Specific data is available covering cost of operating Pierce-Arrow Trucks under all conditions of service, which we will gladly show you.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.

The Worm-Gear

All Pierce-Arrow Trucks are equipped with the worm-gear drive, which is a positive guarantee of effective service under the most difficult conditions.



SIGNAL

MOTOR TRUCKS

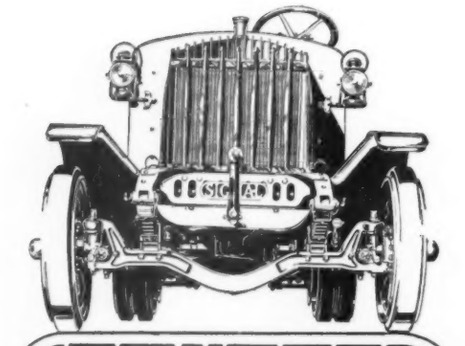
ARE

Keeping Open the Lines of Communication

STRENGTH

"SIGNAL Trucks are *economically* delivering our freight overloads within a radius of several hundred miles around Boston on an average mileage of ten miles to the gallon of gasoline.

"These trucks are doing their bit in breaking freight congestion, and they will undoubtedly continue running on their present schedules even when the railroads catch up. **Signal** trucks are 'clearing the way' now and pioneering a New and Profitable field for hauling companies."



SIGNAL

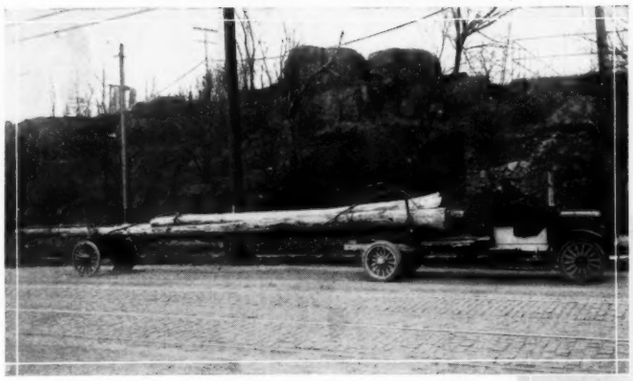
1-1½-2-3½-5 Ton

In SIGNAL trucks needless weight has been lessened but *sturdy* strength has been preserved. Thus you get *durability* and *low maintenance cost.* The scientific cutting down of unnecessary chassis weight —"the dead load"—means *economy.*

Reliable and efficient truck performance is the sum total of all the parts put together *right,* made of the *right* materials and working as a Unit. When all the parts are Correct, then the truck as a unit is *Correct.* The performance of a **Signal** truck is the performance of a *Correct* Unit. Quiet, Dependable, Easily Controlled and Capable in excess of demands.

Signal Motor Truck Company

DETROIT, U. S. A.



SERVICE TRUCK WITH TRAILER (FIFTH WHEEL EQUIPMENT), AS OPERATED BY VIERLING STEEL WORKS, CHICAGO.

SERVICE TRUCK WITH TRAILER AS OPERATED BY J. STILES VAN NESS & SON, CALDWELL, N. J.

shipped by rail in a 40-ton freight car. The new plan will, therefore, relieve 15,000 40-ton freight cars, and will also permit the transportation of 90,000 tons of government materials to the coast from the interior storage depots. The actual number of freight cars which the plan will relieve, therefore, if successful, will be 17,250 40-ton cars.

Working in close touch with the storage committee of the Council of National Defense, which is helping to work out the efficient mobilization of the varied stores of war at convenient central points, the highways transport committee is laying out a comprehensive system of through routes between the truck production centers, the storage centers, and Atlantic coast ports. The routes which are being selected are those which can most easily and clearly be brought into condition to stand the traffic and which will lead most directly from the truck production centers to the seaboard. A central main line or backbone military highway will be selected between Chicago and New York City, and leading to this main line feeder routes from the various scattered motor-production centers. In the East branch routes will lead off the main line north and south to the various Atlantic coast ports.

Officers of the Quartermaster's Department have been for months gathering detailed information in regard to these roads and the possibility of heavy motor-truck traffic over them. State and county officials have been called to Washington and are urged as a patriotic duty in the war emergency to bring local gaps immediately into suitable condition.

Delivering Passenger Cars by Motor Truck

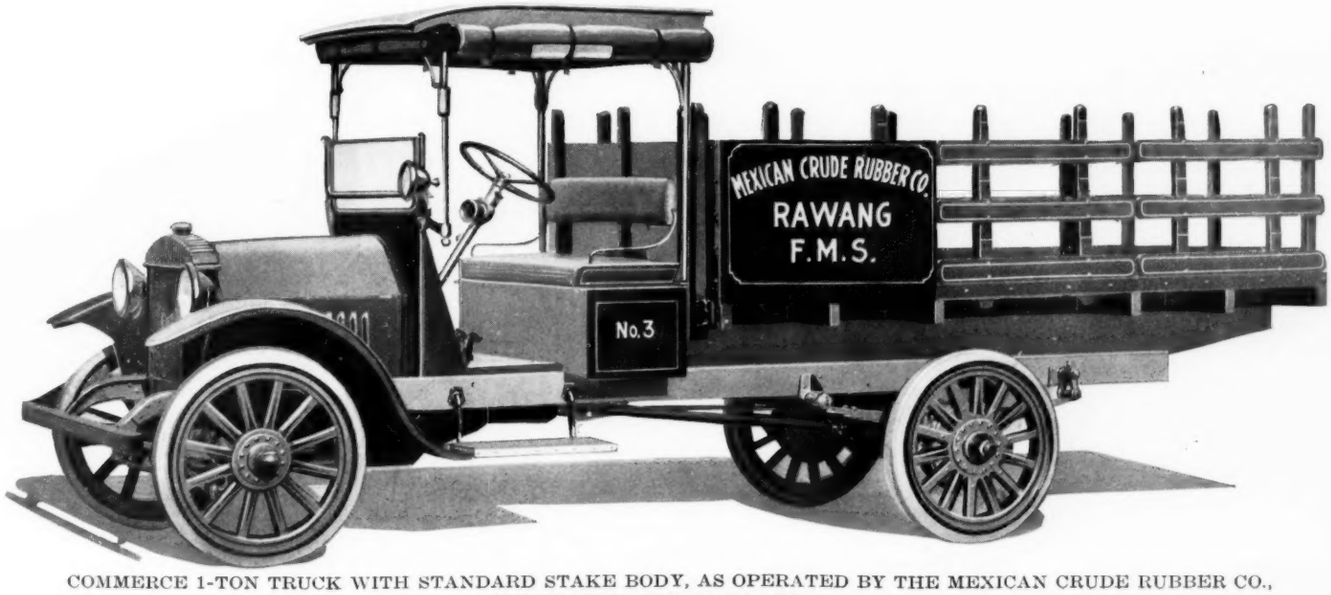
Passenger cars can be hauled in less time on Peerless trucks than consumed by express shipment and at the same cost as by freight. This was demonstrated by the Peerless Motor Car Company of Cleveland, when they sent a shipment of passenger cars from Cleveland to Baltimore on Peerless trucks.

These passenger cars were crated, mounted on the truck body and arrived at their destination without a hitch or a scratch.

The cars were consigned to the Zell Motor Car Company of Baltimore.

This accomplishment establishes the practicability of long hauls and heavy shipments with the motor truck. It also proves the economy of this method of transporting all kinds of commodities by this means.

Based upon the success of this shipment, the Peerless company will handle many others in the same way. Twenty cars



COMMERCE 1-TON TRUCK WITH STANDARD STAKE BODY, AS OPERATED BY THE MEXICAN CRUDE RUBBER CO., FEDERATED MALAY STATES.

U S
MOTOR FLOATING POWER PLANT TRUCKS

Truck Service you can depend upon

Under conditions similar to those that confront the municipal truck in hauling coal or construction materials, twenty U. S. Trucks have made a remarkable record in the service of the George B. Newton Coal Company, of Philadelphia.

This company is one of the largest retail distributors of coal in the world. It works its trucks hard and continuously on long and short hauls.

During the extraordinary weather of the past winter these twenty U. S. Trucks have hauled every day a large tonnage and maintained a dependable service.

In ice and snow they have been operated without chains and maintained the best of traction because of their perfect balance.

The Floating Power Plant has proved its utility in keeping them on the road and out of the shop.

Write for all the facts.

Worm Drive—2½, 3½ and 5-ton. *Chain Drive*—2½ and 3½ ton

The United States Motor Truck Co.
CINCINNATI

U. S. TRUCK AS OPERATED BY J. W. WHITLOCK & CO., RISING SUN, IND., TO HAUL GREEN LOGS TO MILL.

and trucks will soon start to New York and Philadelphia.

The idea of transporting motor cars in this fashion was originated, it is said, by A. S. Zell, president of the Zell Motor Car Company of Baltimore, for years a distributor for Peerless cars and trucks.

Other Examples

The Cleveland Provision Co., a meat packing concern of Cleveland, O., uses trucks and trailers in making deliveries in Elyria and Lorain. The outfit consists of a 3-ton White truck, and one of the Troy Wagon Works Company's 2½-ton trailers equipped with 4-in. rubber tires. Starting from Cleveland the outfit goes to Elyria, where the trailer is dropped and the truck continues to Lorain. Deliveries in Elyria are made from the trailer, horse-drawn, while the truck is delivering its loads in Lorain. On the return trip, the empty trailer is picked up by the truck and taken back to Cleveland.

A similar outfit is used by the Fireproof Warehouse & Storage Co., Columbus, O., for hauling furniture and other goods. The outfit consists of a Sternberg 2-ton truck and a G. M. C. 2½-ton truck, used with a Troy trailer.

Automobile, Equipped With Flanged Wheels, Hauls Construction Material by Rail in Subway Construction

Because both animals and steam proved failures when taken down into the New York subway, the contractor turned to the motor truck for power to transport the requisite materials of construction. After adapting the truck to this underground work, the contractor did not have any more trouble.

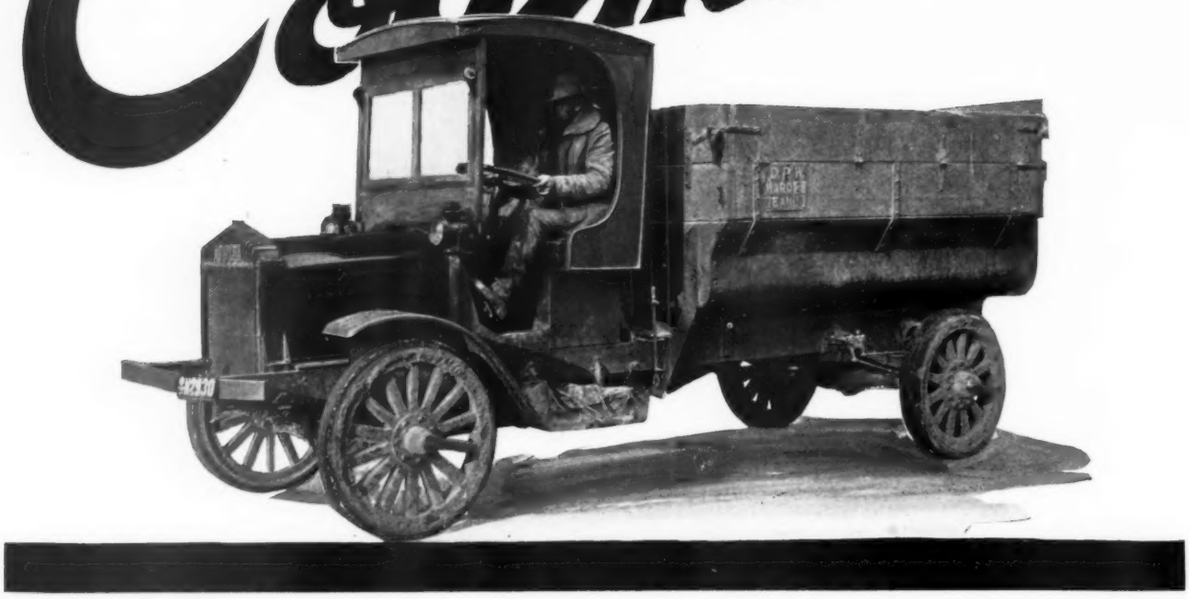
Steam cars were out of the question because of the gases given off from the boiler fires. Flat subway cars could not be used, as the current had not been turned into the third rail. The cross-ties and rough groundwork hindered horses.

Motor Trucks Are Making Abandoned Water Power Sites Active Again

The utilization of water power and the utilization by motor trucks of the good roads of New England are combining to make feasible a development of industrial activities at many points which could not heretofore be reached because of the lack of railroads and of water-power development. Two things have brought into prominence the wonderful opportunities for industry in New England along both large and small waterways, and the sudden realization that in a national crisis that part of the country must at least in part return to its old state of self-sufficiency has turned attention more directly to the utilization of these agencies of the hydro-electric plant and the motor vehicle. It is now possible to transform the power in every river and brook which in ancient days was applied directly and wastefully to industry through the clumsy water wheel to the wonderfully flexible and eco-

CLYDESDALE TRUCKS AS OPERATED 10 TO 12 HOURS DAILY BY GEO. W. TRAVERS CO., HOBOKEN, N. J., IN HAULING GOODS FROM WAREHOUSES TO RETAIL MERCHANTS.

Columbia



"730 Days Continuous Service and not one cent for repairs."

That's the experience of the Pontiac City Mills, Pontiac, Mich., with their 2-ton **Columbia** Truck. "It has been on the job *every* day for two years, and all this time running under its own power over all kinds of city and country roads without a cent for repairs.

"That's why we've never regretted we bought a **Columbia.**"

The **Columbia** 2-ton truck ($1990) is oversize in every part. The **Columbia** 6-ton trailer is priced at $760. The **Columbia** 6-ton combination (including **Columbia** 2-ton tractor-truck) is priced at $2750. **Columbia** trailer and semi-trailer units will be shipped with your **Columbia** trucks or tractor-trucks. No delays.

Columbia Trucks and Trailers are guaranteed for one year from date of purchase. Immediate deliveries.

Columbia Motor Truck & Trailer Co.
PONTIAC MICH.

FRUEHAUF 10-TON SEMI-TRAILERS, DRAWN BY ACASON TRACTORS, EN ROUTE FROM DETROIT TO PITTSBURGH.

MACK 2-TON TRUCK AS OPERATED BY PUYALLUP AUTO FREIGHT, BETWEEN PUYALLUP, AUBURN AND SEATTLE.

nomic electric power. There are many millions of horsepower running to waste in the hills of New England that may now be put to useful purposes. These water-power sites suffered in many instances in the past through remoteness from rail transportation, but this has been entirely eliminated by the motor vehicle. The motor car and the motor truck put the water-power plant that is several miles from the railroad station or village on practically an even footing with the steam plant alongside the railroad and near the homes of the workers.

Fleet of Federals on Detroit-Washington Run

The application of the motor truck to the long distance hauling of freight that could not wait for the railroad traffic congestion to be straightened out was successfully demonstrated by the Federal Motor Truck Company of Detroit in February.

A train of five motor trucks, two of which were loaded with heavy parts, left the factory in Detroit on February 2. A sixth truck was picked up at Toledo and the four empty trucks proceeded to Akron, where they were loaded with tires. The whole train went through to Washington, D. C., without any mechanical trouble whatsoever and only a few hours' delay on account of the very bad road conditions.

The weather was severely cold and the road completely covered with snow, and in some places where the road commissioners had failed to do their work properly there were deep drifts that tied up all traffic for a time. The trucks made the trip in two weeks, a much shorter time than they, together with their loads, could have been delivered by the railroads under the handicap of the traffic congestion.

This trip made by the Federal trucks is taken by transportation experts to be only another proof that motor trucks soon will be very generally used for moving the freight that the railroads are not able to take care of because of the tremendous volume to be moved and the inadequate rail lines and railroad equipment.

Packard Trucks in Intercity Hauling

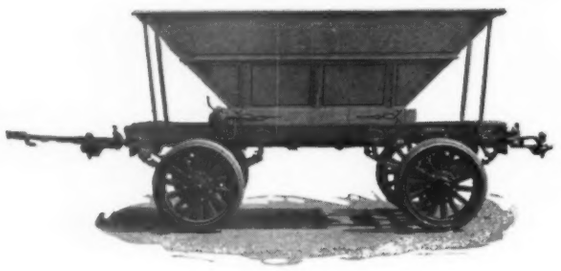
Melvin Savage, a San Francisco lumber haulage contractor, makes frequent trips from San Francisco to Burlingame Hills, 21 miles away. His trucks make three round trips or a total of 126 miles each, daily, over this route. Each truck carries a load of 3,500 ft. of lumber.

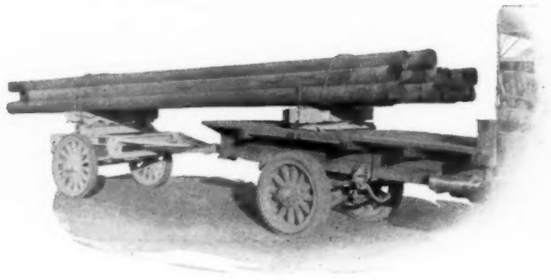
The Spanish River Lumber Company, Ltd., operates a Packard 3-ton truck in the Georgian Bay region in Ontario, to haul supplies to its logging camps. Every day this truck makes a 75-mile trip with a full load, over roads that are typical of the lumbering industry.

For many weeks each winter and spring the road from Cayucos to San Luis Obispo, Cal., a round trip of 45 miles, is one of the worst stretches of road in the state. The Coast

SMITH FORM-A-TRUCK HAULING 1½-TON GIN BOILER FROM KOSSE TO WACO, TEX., 52 MILES, IN 5 HOURS, OVER SANDY ROADS.

HELP WIN THE WAR—BUY THE THIRD SERIES LIBERTY BONDS





Motor Trucks are More Economical when used with Warner Trailers

All good motor trucks have a surplus of power when loaded to their rated capacity. They develop enough to carry their rated load—also to pull an equal load. This point is conceded by all automotive engineers.

Warner Trailers, hitched behind your motor truck, will utilize this surplus power that otherwise goes to waste.

For Light or Heavy Duty Hauling

There is a Warner Trailer for every kind of hauling job. Our two-wheel trailers are especially adapted to hauling pipe for gas and water systems, steel beams and all other work where the load is lengthy for its weight. The model illustrated is used in the oil fields. It has proved a great time and work saver.

For the regular run of loads you can procure Warner Trailers that are built like your motor trucks—minus the power plant. Or with special bodies, as desired.

We Study Your Hauling Problems

Every line of business, and often many firms in the same line, contend with different hauling problems. The conditions they face differ. Each firm should make a survey of the work their transportation units must do and the equipment they employ.

Our expert transportation engineers will aid you in making a survey of your hauling needs. They will recommend the Warner Trailers best suited to your work. If their investigation should determine that your present equipment is adequate and the most economical means of handling your hauling, you will be told so frankly. This service is furnished without any obligation.

Send for Heavy Duty Truck Trailer folder giving further data, photographs of trailers in service, etc.

AN EXCLUSIVE WARNER FEATURE

Our universal Ball and Socket Hitch. No coupling pins. Operates like your shoulder joint. Allows for every conceivable position of the truck and trailer. Eliminates all binding strain in going over bumps, around corners or when truck is going up hill and trailer coming down, even at extreme angles.

WARNER MANUFACTURING COMPANY

108 Bushnell Avenue **BELOIT, WISCONSIN**

Inter-city freight in the future will be largely handled by motor. Warner Trailers make possible the truck trains necessary to such service.

WARNER HEAVY DUTY TRUCK TRAILERS TWO AND FOUR WHEEL TYPES

ACME 2-TON TRUCK AS OPERATED BY THE ENTERPRISE BRASS WORKS, MUSKEGON, MICH.

Trucking Company operates 1-ton, 2-ton and 3-ton Packards over this route. Two or three trips, totaling 90 to 135 miles, respectively, is a regular day's work for each of the trucks, though there are many times when they have to plow through hub deep mud.

Werner Bros., of Chicago, are doing long-distance hauling to Milwaukee and return, a distance of 160 miles. It takes 10 hours to transport a load of household furniture from Chicago to Milwaukee by motor truck. The railroads, even under ideal conditions, cannot equal this time, because Werner Bros. can deliver the load directly to the house in which the owner of the goods is to reside.

The John Wanamaker store in Philadelphia maintains a regular service with Packard trucks to Trenton, 35 miles away, to Wilmington, Del., and across New Jersey to Atlantic City, a distance of 65 miles.

Because he wanted to escape the long delay, work of crating and risk of embargo incident to railroad haulage, C. F. Van Sicklen, of the Van Sicklen Speedometer Co., recently moved his household furniture from St. Charles, Ill., to Detroit, a distance of 350 miles, in a 3-ton Packard truck. The actual running time was 38 hours. The elapsed time was 3 days, 7½ hours.

The Loose-Wiles Biscuit Company, of Chicago, supplies Gary, East Chicago, Morgan Park, Des Plaines, Barrington, Burlington Heights, Evansville, Great Lakes, Fort Sheridan and Waukegan, the latter about 40 miles away, by Packard truck. The installation of truck service has resulted in a large saving of money to the company, and their customers are better satisfied.

A recent example of Packard truck efficiency over a long-distance haul comes from Pittsburgh. Some members of the Pittsburgh Chapter of the Army and Navy League got together 5 tons of Christmas presents for the American troops in France. These gifts had to be in Washington by Monday, October 29, to be placed on board ship. The railroads were unable to assure delivery before time of departure. The Packard Motor Car Company, of Pittsburgh, volunteered the use of a 3-ton truck, and late on the afternoon of Thursday, October 25, the truck, with its overload of 2 tons, got under way. The truck arrived in Washington Saturday afternoon. The total running time was 34 hours. The distance is 380 miles and much of the way is over mountainous roads. The return journey was made in 24 hours' time.

Kissel Trucks in 1,500-Mile Run

One of the early conspicuously successful interstate runs was that of a fleet of nine Kissel trucks from the factory to Baltimore, a distance of 1,500 miles.

The trip from Hartford, Wis., to Baltimore was made in fourteen days, actual running time. Considering the terrific conditons encountered, this is regarded as a remarkable demonstration of what trucks will do when put to the test. Only minor mechanical troubles were experienced, and the drivers believe that in the dry season the trip could be made in five or six days.

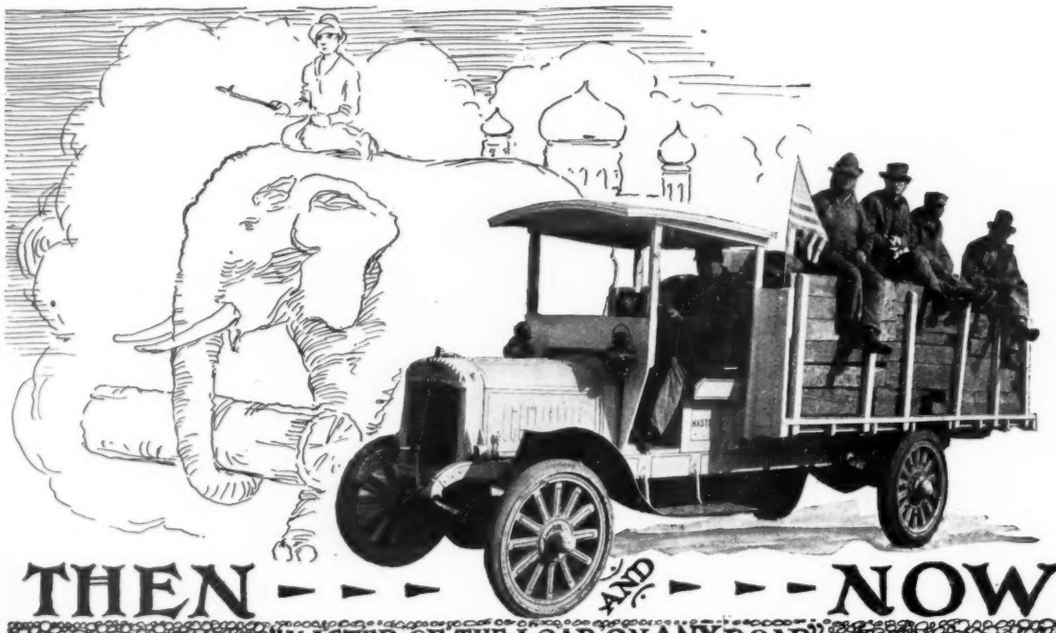
BEAT RAILROADS BY TWO WEEKS

So far as is recorded, no fleet of motor trucks had ever attempted so long and arduous a trip in this country, but those responsible for the venture say that they would not be averse to repeating the experience. In spite of the difficulties encountered, the time consumed was less by two weeks than

TITAN 5-TON TRUCK SHOWING CAB AND FOREDOOR EQUIPMENT AND HIGH ROAD AXLE CLEARANCE.

TITAN 5-TON TRUCK WITH POWERFUL BRAKES HOLDING 5-TON LOAD ON 25 PER CENT. GRADE.

MASTER TRUCKS



THEN - - - AND - - - NOW

"MASTER OF THE LOAD ON ANY ROAD"

"Our Master 2-ton truck was willingly carrying a 4-ton load through a deep, muddy road (three miles west of Winnetka, Ill.) when we came up to a 'stalled,' fully-loaded, 3½-tonner—it was 'in to the hubs.'

"We had no chain 'tow' line to pull it out so we pushed it out. Our 2-ton truck certainly mastered the situation, when under a 4-ton load it pushed a fully-loaded 3½-ton truck out of the way. And we did it at a cost of ten miles to the gallon.

"The **Master** 2-ton truck is a 3½-ton ***'world-beater'*** for actual performance —and the owner saves the difference in first cost."

MASTER TRUCKS

Do Big Things in a Big Way at the smallest operating cost—there is no other truck just like it. Prompt deliveries guaranteed.

The famous **Master** 2-ton truck, light, strong and powerful, with its special **Master** H U Buda Military Motor, sells for only $2290 —**Master** 3½-ton, $3690 (worm)—**Master** Tractor, $2550.

Write for full information concerning the exclusive **Master** Hydraulic Hoist and Dump Body, and the special body designs for every purpose. Few Open Territories for Good Salesmen.

MASTER TRUCKS, Inc.

3145 South Wabash Ave. CHICAGO, U.S.A.

DESIGNED BY MASTERS - - - BUILT BY MASTERS

PACKARD 5-TON TRUCK, AS OPERATED BY THE NATIONAL TUBE CO., PITTSBURGH, PA., IN DELIVERING IN PITTSBURGH AND SUBURBS.

was necessary under the then freight situation to get delivery by rail.

As an indication of the obstacles overcome on the grilling trip, the following statement by Jimmy Wendell, one of the drivers, is interesting:

SOME DIFFICULTIES ENCOUNTERED

"We encountered rain, hail storms, snow, mud, quicksand, washed out bridges and roads. On one of the real muddy roads 18 cars were in one mudhole, and we were included in the bunch. Each one in our crowd pulled out under our own power. Time and again we dropped so deep that we could hardly see the hubs on the wheels, and our axles and differentials were not to be seen at all. We used up all the fence rails, stones, ropes, and, in fact, everything that looked as tho it would give the wheels a chance to grab hold of. If it had not been that all the boys were experienced in this kind of work, I doubt if we would have made the time. As it was, the strain on us due to the wear and roads was the limit, which necessitated our resting nearly two days. All were once directed the wrong way, which consumed nearly 200 miles. No more trouble was experienced with the loaded trucks."

Truck Grades 40 Miles Per Day

A saving of $687.50 a month is reported by Road Commissioner O. R. Cook, of Washington County, Miss., who operates a 5-ton truck.

"I can pull two heavy traction graders thru any ordinary soil and travel 40 miles a day," said Commissioner Cook, "or I can pull a heavy drag weighing 1,600 pounds, covering 30 ft. of road width, 50 miles a day. The average speed is about 4 miles per hour with either grader or drag. This truck and four men have done the work of 20 mules and six men, and I think its life will be equal to any other kind of engine doing the same class of work."

Commissioner Cook furnishes the following figures, giving a comparison of the cost of operating the truck per day and the cost of operating the equipment displaced by the truck:

—Cost of Mule Teams Per Day—		
Feed	$10.00	
Hire of 20 mules	20.00	
Hire of 6 men	9.00	$39.00
—Cost of Motor Truck Per Day—		
25 gallons of gasoline	4.00	
3 gallons of oil	1.50	
Hire of 4 men	6.00	11.50
Daily saving		$27.50

Saves on Heavy Timber Haulage

Because a Nash Quad proved its ability to negotiate the heavy mud roads leading into a tract of timber near Erie, Pa., after teams and rear drive trucks had been abandoned in despair, the Conneaut Shovel Co., of Conneaut, Ohio, saved 40,000 ft. of first quality white ash.

"We purchased this timber under a contract with a teaming concern to haul the logs into Erie at $7.50 per thousand, loaded on the train," says G. W. Benton, Secretary-Treasurer and Manager of the Conneaut Shovel Co. "The teamsters went into the woods with three big teams and worked two months. At the end of that time they had made no advancement, and

LOCOMOBILE TRUCK WITH FIFTH WHEEL TRAILER, AS OPERATED BY THE PIERCE-BALCH LOGGING CO., CENTRALIA, WASH., CARRYING LOAD OF 107,000 SHINGLES WEIGHING 10 TONS.

The Transportation Problem

THE Railroads *must* be relieved—Goods *must* be moved—The wheels of industry *must* be kept moving—

The Solution of the Problem lies in the use of Motor Trucks for all hauls of one hundred miles or less—Wilson Transportation Engineers will help you in the adaptation of Wilson Trucks to *your* transportation needs.

Wilson Trucks are the product of more than thirty-five years experience in the building of heavy duty transportation vehicles. One, two, three and one-half, and five-ton worm drive models.

We can use a few more dependable dealers in Eastern and Mid-Western Territory

J. C. WILSON COMPANY, Detroit

we were forced to loan them money to continue their contract, incidentally advancing the price per thousand to $10.50. They finally threw up the contract.

"We then tried to sublet the job, but found that its was impossible to get any one to undertake it. I called a directors' meeting and laid the case before them. They suggested trucks.

GOES WHERE TEAMS CANNOT

"When we tried the Quad on the timber we found that we could bring the logs from Erie and deliver to our factory for almost the same amount that it would otherwise cost for just hauling it to Erie and loading it on the train. In other words, we effected a saving of $7.00 a thousand in bringing in this timber.

"Since that time this truck has been driven thru the deep sand along the shores of Lake Erie, where teams were unable to load up their quota of sand and pull out. We have climbed wash banks on the creeks south of here with loads of logs, where all teams, trucks and automobiles gave up in despair. We even drove into a molding sand pit, where no team has ever been able to pull a load out, and where four horses are often stuck with a light wagon. We backed thru this pit when one end of the truck was sunk so far down that the frame dragged on the sand. But our truck pulled out with scarcely an effort."

Intercity Trucking Companies Organized

There are at least two trucking companies that operate trucks between New York and Philadelphia. One has a fleet of 22 5-ton trucks that operate on a daily schedule between the two cities—a distance of 90 miles. In addition, contracts are taken for special trips to Baltimore and Washington, Harrisburg, Pittsburgh and to New England cities.

Recently a company was organized in Detroit to operate a fleet of motor trucks with trailers, at 3-hour intervals, daily, over the 40-mile route from Detroit to Toledo. Practically all shipments from the rubber factories in Akron, O., to Cleveland are made by motor truck.

Trucks Plow Through Snow Between Chicago and Racine, Wis.

A successful intercity run, under difficulties, is reported by H. B. Hall, president of the Chicago Bethlehem Sales Company, 2241 Michigan avenue. A long-distance call from the Bethlehem factory at Allentown, Pa., for steering gears for use in army trucks, was responsible for the dispatching of Bethlehem trucks to Racine to the plant of the Lavine Gear Co.

Both trucks, one of 1¼-ton capacity and one of 2¼ tons, negotiated the round trip without difficulty. At many points they plowed through snow drifts, with great bulk loads, apparently without effort.

The complete shipment of steering gears was delivered to the Chicago express office the morning following the call for help, which was received by Mr. Hall at 4 o'clock in the afternoon.

(*Continued in May Issue*)

Dump Truck Powered with Wisconsin Motors

CONSISTENT

The standard power for municipal trucks

Write for specifications on different types and sizes.

WISCONSIN MOTOR MFG. CO.
Station A. Dept. 330
MILWAUKEE, WIS.

New York Branch,
21 Park Row,
T. M. FENNER, Factory Rep.

HELTZEL

DOUBLED THE PERFORMANCE OF SHOVELERS, DRIVERS AND TRUCKS
TILGHMAN H. MOYER
CONTRACTOR
ALLENTOWN, PENN.

LIGHTNING LOADER SKIPS

Illustrated literature containing cost data sent free on request.

Help Win the War! *Speed up* your unloading and release your cars (for the other fellow).

"Heltzel Loader Skips," says the Carnegie Steel Co., "(and we have eight of them at our Ohio Works plant) handle concrete aggregate (slag and sand) *rapidly.* They do not leak, are easily handled, give a clean discharge and stand up under hard, continuous usage. They enable us to do our loading from open cars to industrial cars in *less* time with *fewer* men."

Heltzel Steel Form & Iron Co., Warren, O.

The Road Locomotive

Neither Embargoes nor Extreme Weather or Highway Conditions Bar Duplex Direct Shipments

DUPLEX 4-WHEEL DRIVE

11th Year

Application of *time-tested,* yet *exclusive* Duplex 4-Wheel Drive principles—

Correctness of design with *painstaking attention* to minutest details—

Careful selection of *right materials,* supported by *ten years of experience* in truck construction—

These fundamentals in Duplex Truck building have justified our claims for its *dependability, ruggedness* and *durability.*

With traffic tie-ups imposing restrictions on shippers, the Duplex is the logical solution to the transportation problem. It is dispatching consignments of freight with *time-table certainty*—giving *year*-'round, never faltering service.

The Duplex has the inherent *power* to accomplish as an *every-day duty* titanic haulage tasks that are not attempted by no other type of motor truck.

Let us send you Duplex haulage facts and figures for your particular business. Write for "Duplex Doings," issued in the interest of economical and better transportation methods

Duplex Truck Co. 2050 S. Washington Ave. **Lansing, Michigan**

"Our Schacht 3½-Ton Truck has been working Six Days a Week for over a Year.

"And the loads have been heavy and the hauls long, yet it has never failed us. The cost of repairs do not exceed $25.00 up to date." All because **Schacht** frame and axles of special heat-treated steels have a four-fold margin of safety. Substantial **Schacht** Construction means Low Cost of Upkeep. Low gasoline and oil consumption due to unusual carburetor and engine efficiency.

Schacht Trucks are made (not assembled) in the **Schacht** plant, and the **Schacht** Sales Plan includes *generous* discounts, *liberal* treatment and *strong* co-operation. If it's trucks, write **Schacht.**

Immediate Delivery

2, 2½, 3½ and 5-ton capacities.

The G. A. Schacht Motor Truck Company

Factory and Main Office, Cincinnati, Ohio.

Chicago Branch:
2422 Cottage Grove Avenue

New York Branch:
422 East 54th Street

FEDERAL

A Size for Every Business

Another FEDERAL

This 1½ ton Federal is proving Federal reliability for the Fort Smith, Ark., Fire Department. It is used as a combination chemical and hose cart.

Fire Departments Demand Federal Reliability

The fire alarm rings—a home or, perhaps, a whole city depends upon the reliability of the motorized fire trucks.

Trucks used in this service must be of proven reliability. They must have power, strength and stamina to a marked degree.

This is why you find the Federal chassis being used so extensively in fire department work. Federal is reliable. Federal never fails to respond.

In every department of municipal work Federal Motor Trucks are rendering an unusually economical, dependable service—a service that reflects credit upon the men who purchase these trucks.

Write for *"Federal Traffic News."*

Federal Motor Truck Co.

354 Federal St. Detroit, Mich.

The Super-Service Truck

DIAMOND T
TRUCKS

EVERY advantage of intelligent engineering practice that accrues from the use of standardized units, is found in Diamond T trucks.

Our own highly efficient engineering and factory force, are augmented in the building of Diamond T trucks by the best engineering brains in the motor truck parts industry.

When you buy a Diamond T truck you purchase the maximum insurance against dissatisfaction and mechanical difficulties.

YOU get economy from the start—in first cost, service efficiency and upkeep and operation expense, proved by the fact that **no Diamond T has ever worn out.**

For every delivery need, there is a Diamond T truck—five standard models of the highest types—capacities one to five tons.

Increased factory facilities enables us to make **prompt deliveries.**

Before you buy any truck it will pay you to see the Diamond T dealer in your territory, or write us for detailed specifications.

Diamond T Motor Car Company

Factory and General Office,

4505 West 26th Street **CHICAGO, ILL., U. S. A.**

Kissel Trucks are Making Good in Interstate Haulage Work—

A YEAR ago last March a fleet of nine Kissel Trucks, loaded with Kissel Passenger Cars, made a record trip from Hartford, Wisconsin, to Baltimore, Maryland—a distance of 1200 miles in less than fourteen traveling days.

In different parts of the country, Kissel Trucks are establishing similar records every day in inter-city and inter-state haulage and delivery of freight and merchandise.

KISSEL TRUCKS

BUILT IN FIVE NEW SIZES

The reliable Kissel-built power-plant, brakes, springs, and improved worm-drive rear axle, are proving a veritable guarantee of uninterrupted performance and a 24-hour-service-stamina.

The ALL-YEAR Cab enables truck drivers to keep their trucks in operation the year 'round, regardless of weather conditions. In summer, it is quickly changed to a cool, open housing.

Let us send you data on Kissel Truck performance in transportation, as well as in all branches of municipal and government work.

KISSEL MOTOR CAR COMPANY, Hartfotd, Wis., U.S.A.

A New Page in Fire Fighting History

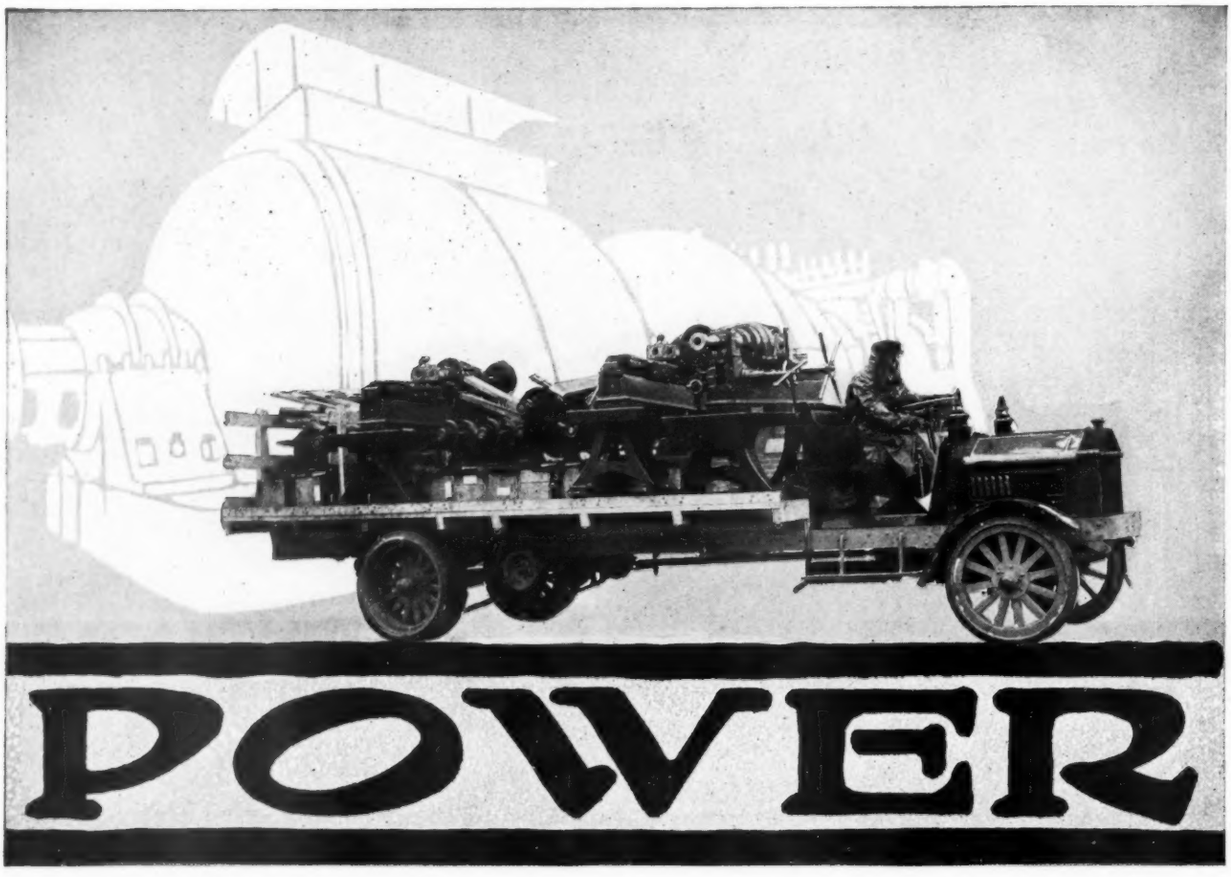
Not a built-over pleasure car or truck chassis to carry your equipment, but *real* fire apparatus "all the way through" —that's ***South Bend "Double Duty"*** Fire Apparatus.

Quicker "get-away," more power, greater speed, increased rapidity of "pick-up," wider range of high-gear activity, easier control, sureness of sustained speed and absence of undue vibration at *all* speeds!

Study some of the "Double Dutys" that are breaking fire fighting economy and efficiency records. Note that they all *fit!* Not a loose, "one-style-for-everywhere" adaptation, but a "tailor-made" fit to existing needs! Each and every piece built to suit your requirements by fire apparatus *experts.* That's South Bend *"Double Duty."*

Eastern Representative:
WALTER M. HELLER, 142 Market St., Newark, N. J.

SOUTH BEND MOTOR CAR WORKS
SOUTH BEND, IND.



"Deep sandy and thick muddy roads have failed to stall our HALL 5-ton trucks which we are now using in the long distance freightage of machinery. Even under overload our HALL Trucks stand up and **go right thru—and keep going,** *day in and day out,* **every** *day."*

POWER! In Reserve!! That's a Dominant Feature in HALL Trucks—they're *higher*-powered. In *excess* of all requirements and equal to any emergency, the HALL Power Plant not only turns every drop of its fuel into Spontaneous and Flexible Energy, but it always contains an Ample Reserve of Dependable power so neceseary for that *extra hard* pull—that *supreme effort* at the top of the hill.

That's why HALL Trucks (under excessive loads and in deep going) have the punch to deliver when called upon. "A HALL Truck will go through anything or climb anything on which its wheels can secure traction." **Haul it in a HALL.**

THE LEWIS-HALL IRON WORKS

Manufacturers of the HALL Truck
(Established 1873)

Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

New York Distributors: R. D. King Motors Co., Inc., 9 Central Park West, New York City, Metropolitan Dealers.
New England Distributors: Hall Motor Truck Co. of N. E., 1123 Commonwealth Ave., Boston, Mass.
Guarantee Automobile Exchange, 629-31 N. Broad St., Philadelphia, Pa., Philadelphia Dealers.

EDITORIALS

1918 a Big Construction Year, After All

For the man in the construction watch tower there have been dark days in recent months. At times the outlook for construction in 1918 was not bright. Now the outlook is not merely fair, considering, not merely good, but decidedly good, and very likely to become better as the season advances.

The winter-time failure of the steam railroads has cleared the public view of the value of dependable highways. Highway enthusiasm reached its lowest ebb when the text of Priority Order No. 2 classed hard-surfaced roads with musical instruments and other things held unessential to winning the war. But Priority Order No. 2 is gone, let us hope never to return. Official Washington is not likely to "make the same mistake twice" with reference to good roads. From now on, every sign indicates, Washington will encourage road construction where it is considered essential to the military needs of the nation and where it is essential to facilitate the movement of commodities.

While the assertion that this is to be a big construction year is not predicated solely on the outlook for highway construction, that type of construction is so much in prospect that, standing alone, it would insure a busy year for the engineering construction industries.

It is stated on good authority that the federal government, the state governments and the counties will spend on highway improvement in 1918 the great sum of $263,096,610. This announcement is based on the first detailed survey of the nation's road-building plans as conducted by officials of the touring bureau of the B. F. Goodrich Rubber Company. These trained observers have been in daily contact for two months with the highway commissioners of the several states.

But is this such a large sum? It is. Everything is relative, and the significance of this great sum can best be appreciated by comparing it with the corresponding figures of other years. This sum exceeds by 82 per cent the expenditures for a similar purpose in any previous year. It exceeds the amount spent on highway improvements in 1917 by $118,797,750. And that is by no means all. Those in the best position to judge, the federal and state road officials, say this is only the least part of what should be spent for highway betterments before the end of the war, a war which it now appears is not likely to be a short one, reckoning time from the present.

Roads are coming to be appreciated as a vital part of the country's transportation system. They must supplement the steam railroads. Government officials calculate that, with good highways, motor trucks are capable of carrying approximately 200 per cent more freight than the railroads. The inexorable logic of the situation cannot be ignored or denied. The roads will be built.

But what of the labor situation? It is likely to be better than a year ago, for the reason that the man power of the nation is really being mobilized at last, not merely for fighting, but for all manner of productive enterprises behind the lines. Millions of adolescent youths who formerly whiled away the sunshiny days of summer in the pursuit of a baseball will turn their energies into productive channels this year. In general, idlers will catch the spirit of the times and get busy and workers will speed up.

But what of the expense? People are paraphrasing Farragut's "Damn the torpedoes! Go ahead!" They are not in a mood to hold back because of the increase in the cost of roads. They are beginning to understand that the higher cost is partly because of better construction, and also that costs were very low until recently and are not likely soon to be as low again.

And what of the attitude at Washington toward road construction this year? Good, and growing better each day. Just recently William G. McAdoo, Secretary of the Treasury and Director General of the Railroads, in a letter to Governor Charles H. Brough, of Arkansas, encouraged street and road building this year, and said there was no railroad embargo against the movement of material for this work.

So much for highways. When we turn to public utilities such as street railways, light, heat and power plants, water works systems, etc., we find Secretary McAdoo writing to President Wilson, urging that such privately owned utilities be granted higher rates to enable them "to meet alike the public requirements for service and the corporate financial needs upon which that service depends." He continued: "As Secretary of the Treasury I must take official notice of these matters. It is obvious that every part of our industrial and economic life should be maintained at its maximum strength in order that each may contribute in the fullest measure to the vigorous prosecution of the war. Our local public utilities must not be permitted to become weakened. The transportation of workers to and from our vital industries **and the health and comfort of our citizens in their homes** are dependent upon them." Certainly that statement proceeds from a man who favors the normal expansion of all public utilities during the war. Naturally, the same principles apply with regard to the normal extension, maintenance and operation of such utilities when publicly owned.

At no time has the government frowned on making an "urgently" needed public improvement. We shall not attempt to define the word urgent as used in this connection, but this much is very clear and of the utmost significance: The government now holds improvements urgent that it considered unessential but a few months ago, and even then was willing to approve many more projects than the public at the moment supposed.

All honor to the workers in the construction field who appreciated the vital relation between their activities and the national welfare, and who, despite the risk of being called selfish, were courageous enough to urge that construction work go on. Their point is sustained.

Better Pay for Railroad Civil Engineers Will Help All Civil Engineers

At the time of writing it is reported that the United States Government Railway Wage Commission looks with favor on the plea made in the interest of technical men employed by railroads that the Director General of Railroads be advised to increase the salaries of such men as well as of other underpaid men in the railway service. If such an increase in compensation is granted railway civil engineers it will naturally help all other civil engineers, as it will immediately raise the standard of compensation for engineering services. The benefit to the profession as a whole will vary directly as the rate of increase granted the railroad civil engineers.

For many years past the railroads have been the largest employers of civil engineers. The average engineer has had some railway engineering experience—many have had too much. In the fullness of his inexperience, and in an unguarded moment, the average civil engineering graduate has been pleased to accept a railroad job. He has kept the job for a period depending on several factors, prominent among which may be mentioned the rapidity of his rise in the organization, the rate at which he has acquired a working knowledge of business life, and the rate at which he has acquired what Bacon called "impediments to great enterprises, whether of virtue or of mischief," namely, a wife and children. Unquestionably the latter "hostages to fortune" have kept many a man working for the railroads after fear of punishment had gained the ascendency of hope of reward.

The civil engineer has served the railroads well. After acquiring expensive tastes and habits in college he has graduated to the railroad drafting room or surveying party, where he has found life long on service and short on reward for service. He has humped over the board for weary months and years on end, without catching a glimpse of the finger beckoning to advancement. He has meandered the face of the earth, laying out lines over which his fellow-men could travel in speed and comfort. He has sparred with mosquitoes with one hand and with the other dug "chiggers" from his quivering flesh; he has shivered in the cold blasts of the north or shifted from one burning foot to the other while standing behind a "gun" on the blazing turf of Oklahoma. He has marooned his family in a big-city flat while he lived in a rag house in the remote wilderness. He has liberated much love in his work and has had his greatest reward in knowledge of service rendered his country and his kind.

While the few railroad engineers have been well paid, the many have been cruelly exploited. The low wage paid him has fixed the standard for his brother engineers engaged in other lines. It will be nothing short of poetic justice if the railways, who were first in holding down the engineer, should be first in raising him to a higher plane of compensation.

Serving Our Field

The service rendered its field by MUNICIPAL ENGINEERING is most helpful to its large and rapidly expanding clientele of subscribers and advertisers.

The subscriber gladly pays the subscription price for the many original contributions expressly prepared for this publication by conspicuously successful workers in the field, and he is also given heaping measure in the form of service. The advertiser cheerfully pays the card rate for the opportunity of stating his proposition to the reader, but that is only the first element of value he receives in exchange for what he pays. He obtains service in addition and this co-operation is diverse in character and of high value.

To understand the nature of the service rendered the field, the field itself must first be appreciated. What is the field? This publication is edited primarily for those who are engaged in the design, construction, operation and maintenance of hard-surfaced roads in city and country, of water works systems, of sewerage systems, of water purification and sewage treatment plants, of refuse disposal plants, of bridges and buildings, and of drainage and irrigation systems. These works are constructed by companies specializing in these types of contracting and are designed by civil, or municipal and sanitary engineers in city, county, state or federal service, or in the employ of private corporations—this is the field in which MUNICIPAL ENGINEERING dominates. Its editorial pages tell the story.

This editorial scope, coupled with the editorial policy, not only holds a large and growing following among the leading engineers and contractors engaged on work paid for from public funds, but also among leading engineers, responsible contractors and alert plant superintendents engaged in the work of similar privately financed enterprises, such as telephone, gas, electric light, street railway and central heating utilities. It is a great privilege to serve the most influential men, the leaders, in this field.

Thus to a great extent this is a technical publication, but it is also a newspaper giving the latest construction news; the news in narrative form of big work coming up; the news of new machines, devices and materials; and all the essential news of the motor truck industry covering motor truck operation and accounting, the latest application of trucks, as in relieving railway congestion, the relative economy of truck and horse haulage, etc.

Too much emphasis cannot be placed on the fact that this publication is broader than its name. Originally it was called "Paving" when founded in 1890. It was founded to serve the needs of those engaged in street paving and has retained the lead in that field. Later the title was changed to "Paving and Municipal Engineering," but as paving is clearly included in the accepted meaning of municipal engineering it was dropped from the old to form the present title. Since that time the field of the publication has widened though the name has not changed.

Service to readers, in addition to what is given on the printed page consists of the giving of practical advice and information to individual correspondents on all matters pertaining to our field, of whatever nature. This service is rendered to the reader of a value many times greater than the nominal subscription fee which he pays.

The preparation of practical and attractive advertising copy is but the starting point in our service to advertisers, and there is no finishing point as the service is of indefinite extent. Aside from a special Daily Bulletin to all advertisers, letters giving hot tips on desirable selling connections and sales opportunities go out to advertisers in a steady stream. Many of our advertisers owe their selling connections and even the personnel of their sales forces to MUNICIPAL ENGINEERING, and "this co-operation in distribution" is invaluable.

PAVEMENT DESIGN AND CONSTRUCTION

Considerations Affecting the Design of Pavement Foundations

By H. J. Fixmer, Engineer Paving Division, Board of Local Improvements, Chicago, Ill.

In designing foundations for the various types of pavements we must consider the nature and preparation of the subgrade or natural foundation, the kind and weight of the possible traffic and the character of the wearing surface.

Pavements from the structural standpoint may be divided into two general classes. These are the monolithic and the compound construction. In the monolithic form the wearing surface is integral with the foundation, a mass or unit construction. In the compound form the wearing surface is composed of a yielding layer, a semi-monolithic layer or a rigid monolithic layer, superimposed on an artificial foundation, which in turn may be of a yielding nature or of a rigid nature.

The monolithic pavements (and roads) are compacted earth, sand-clay, oiled earth, gravel, water-bound macadam, cement, concrete and monolithic brick.

The compound pavements are bituminous macadam, bituminated concrete, asphaltic concrete, sheet asphalt, brick on a sand or mortar cushion, creosoted wood block, sandstone block, granite block and steel wheelways (car tracks).

Traffic

In designing any structure we must first of all consider what forces the structure must sustain. A pavement is a structure designed to accommodate the traffic using it in an economical, safe and efficient manner. We must know the kind and weight of the most destructive unit which will use or be permitted to use the pavement. The heavy, fast-moving auto truck with a maximum weight of from three to eight tons on a single wheel appears, at this time, to be the "force" we must design our pavement structures to resist. It may be possible to so regulate and route the traffic as to permit a lighter construction on local or inferior streets by prohibiting travel on any such street by any vehicle exerting more than one or two tons on a single wheel. Until such regulation is established by a proper consideration of the economic factors involved, we must design our pavement structure throughout to meet the exacting conditions of modern commercial traffic.

Subgrade

It may be safely stated as an economic proposition that the maximum strength of the subgrade should be developed before placing any type of pavement upon it. The subgrade, together with its drainage system, should be a permanent construction. To this end particular attention should be given to securing a subgrade of as near uniform maximum strength as possible. From an engineering standpoint, if the subgrade is to be prepared in such manner that it will be permanent, it is imperative that the top surface be located at a grade or elevation that can be maintained far into the future. For this reason it is considered desirable, particularly in city streets, deliberately to locate the subgrade surface from 2 to 6 ins. below the normal elevation. This can be done with a proper design without inconveniencing either the vehicle or pedestrian traffic. This provision will permit strengthening the foundation later on by the addition of an extra layer, or permit resurfacing with a deeper and more durable surface.

The material of a subgrade consists of a porous, semi-porous or an impermeable earth. It varies, often on a single construction, from deep sand to compact clay. On the typical country road the drainage is taken care of by the deep side ditches and drain connections to open water courses. As a rule the road is built on a fill, and even where cuts are encountered the longitudinal grade, with side gutters, takes adequate care of the surface water. In urban districts, however, the pavement is invariably constructed in cut or below the established surface of the adjacent ground.

Side Drains

Particular attention must be given to keep the subgrade free from water, for water destroys the uniformity of clay subgrade by softening, facilitating movement and by freezing, causing expansion. Where a permanent waterproof wearing surface is used the water can pentrate into the subgrade only from under the curb or along the gutter face of the curb where the curb and pavement have separated. It is obvious, therefore, that the water should be intercepted and collected by some type of drain or channel under or adjacent the curb. Where the soil is porous and the waterplane is ordinarily at least 2 ft. below the surface of the subgrade no provision for drainage is required except at sumps or changes in the character of the soil structure. In mixed or clay soils provision should be made to carry away the water. This is done by laying a tile drain or a "blind drain" composed of a layer of gravel, stone, coarse cinders or coarse sand from 3 to 24 ins. deep and about 1 ft. wide and connecting the drain at intervals with a catch basin, built to take care of the surface drainage, or to a sewer inlet. The depth and size of the drain will be determined by the porosity of the soil and the probable amount of water to be removed.

The subgrade must be properly and uniformly compacted. This is done by careful rolling with a heavy roller, except where the soil is sand.

Backfilling Trenches

The manner of backfilling trenches and excavations for manholes and other underground structures should be given particular attention. In sandy soils the surface and all openings and depressions can be compacted by judicious application of water. In clay and similar soils care must be exercised to provide against any initial or progressive settlement. Where the depth of the trench is less than the width of the trench below the subgrade surface it should be backfilled with sand or other readily compacted material. Likewise, all excess openings around catch basins and manholes should be filled in with sand or material which will settle by flooding. Deep trenches should be tamped and flooded. The tamping should be more rigorous adjacent the sides of the trench for a distance above the pipe or conduit equal to the width of the trench. This method of tamping tends to reduce the pressure on the underlying pipe and creates an arching effect in the earth structure, which contributes to the stability of the trench backfill. If possible, a disturbed subgrade should be allowed to settle for a year before building the pavement.

Oiling Subgrade

As a factor of safety against the inaction or inefficiency of the side drains along the curb, it might prove both wise and economical to render the subgrade waterproof, water repellant and more compact. In my opinion, the ideal method of securing a crust having the maximum degree of compression and water tightness is to loosen the upper 4 to 6 ins.

of the subgrade surface, harrow it, apply from one half to one gallon of asphalt oil or bituminous cement per square foot and roll with a roller having projecting or "sheep's foot" tampers. The surface should be finished smooth and parallel with the contour of the finished pavement.

Artificial Foundation or Base

There are, apart from the monolithic types of pavement previously mentioned, four general types of pavement foundations. These are, the Telford, or hand-set stone; macadam, either new construction or old macadam reshaped; concrete, either new or old monolithic concrete badly worn, and old block pavement suitable as to surface and grade.

The main purpose of the artificial foundation is to support the wearing surface uniformly and transmit all traffic pressure to the subgrade below. On a uniform subgrade it should be of uniform strength or thickness. Where weak places exist in the subgrade and can not otherwise be remedied, the foundation must be proportioned to equalize these defects. To do this will require a radical change in the customary application. Instead of providing for a base of constant thickness or standard composition, it will be necessary to state the limits or variations and provide for bidding on a cubic yard basis rather than the customary square yard basis.

An old block pavement, because of the established grade and its slight unevenness, is suitable if the traffic is light for resurfacing with an asphalt top on a binder course. As a rule, the traffic is too heavy, in which case the wearing surface is removed and the base alone utilized. Practically all new construction is placed on a macadam or concrete base. Both these types of base have an affinity for water. Macadam through absorption and capillarity tends to keep wet. Concrete absorbs water from above as well as below. Recent observation in buildings indicated that concrete weakens and slightly but progressively disintegrates where kept more or less moist. In view of this fact, where permanent construction is planned for, it might be well to give more thought to waterproofing the subgrade by the application of oil as previously suggested. In determining the thickness and composition of the macadam or concrete base we must know the traffic weight to be sustained and the permissible weight the subgrade can safely support. The matter of thickness, richness of mix and need of reinforcing as applied to a concrete pavement is an economic problem. Strength in concrete can be secured in these three ways or by a combination of these features. In the case of macadam strength can only be secured by increasing the thickness, assuming, of course, a good material properly consolidated.

Wearing Surface

In all cases provision must be made for a wearing course of uniform thickness in order to secure uniform wear and reduce the amount of maintenance. Whether the wearing surface is of a yielding nature or of solid monolithic construction, its strength as part of the foundation should, as a rule, be ignored. This is rational in view of the effect of wear, possibility of replacing with another type of surface and disturbance of continuity due to underground repairs. The combination of a given type of base with a given type of wearing surface together with the condition of the subgrade requires study. Heavy traffic generally requires a rigid base. A yielding wearing surface may employ a yielding base where the traffic is light and mostly horse drawn. Concrete bases vary from 4 to 8 ins.; macadam from 4 to 12 ins. It is an economic problem to determine the best construction. The factors of first cost, available materials, maintenance and public convenience must be duly considered. Under prevailing conditions it may be advisable to spend more on developing the strength of the subgrade than increasing the strength of the artificial foundation. Investigation, experiment and science are necessary in evolving the efficient structure for a given location and a definite traffic stress.

Construction Plant and Methods Employed in Building Concrete Roads in Wayne County, Mich.

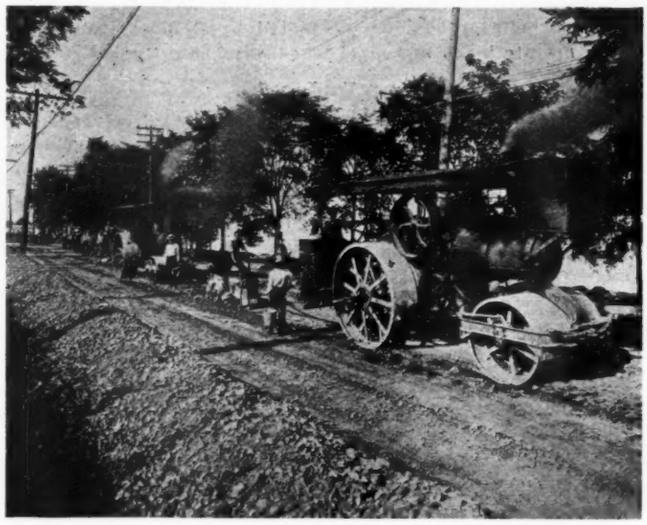
The construction of concrete roads in Wayne County (Detroit), Michigan, has developed to a point where the procedure employed is the best obtainable both from the standpoints of results secured and expense incurred a description of the methods employed, as promulgated by the Board of Commissioners, forms an important chapter in the classic literature of American highway engineering.

Preparing Subgrade

After the road has been staked out and as soon as the weather will permit in the spring, the subgrade is prepared and shaped. The major position of such work is done with scarifiers and graders, the hauling power for which is furnished by steam tractors or rollers. Careful attention is given the grade to eliminate soft, spongy places and a 10-ton roller is used to roll it hard. To produce a good concrete road, thorough drainage is necessary in addition to a good subgrade. Both proper grade and drainage are difficult to cope with in Wayne county, as the county, for the most part, is flat and situated in a valley not easily drained. The subsoil is largely of heavy, sticky clay, with some loose, deep sand.

Using Industrial Railway on Long Hauls

The great problem has been in getting the materials on the subgrade, and various plans are followed on the different roads, due to varying conditions. On long hauls an industrial railway is used to transport all materials from the point of



IN PREPARING THE GRADE FOR CONCRETE ROADS IN WAYNE COUNTY, MICH., MACHINERY IS USED WHENEVER POSSIBLE.

receipt to the point of construction, consisting of one or more 7-ton, 30-h.p. locomotives, 60 or more 1,000-lb., double-side, V-shaped steel dump cars, each of 1½ yds. capacity, and 8 16-ft. flat cars, all of 2-ft. gage. The track is furnished in built-up units, 15 ft. in length, consisting of steel rails fastened to steel ties. A turnout may be laid wherever needed by replacing a section of track by a switch or curve, as this is also furnished in 15 ft. lengths and of such radius that locomotive and cars will readily pass through.

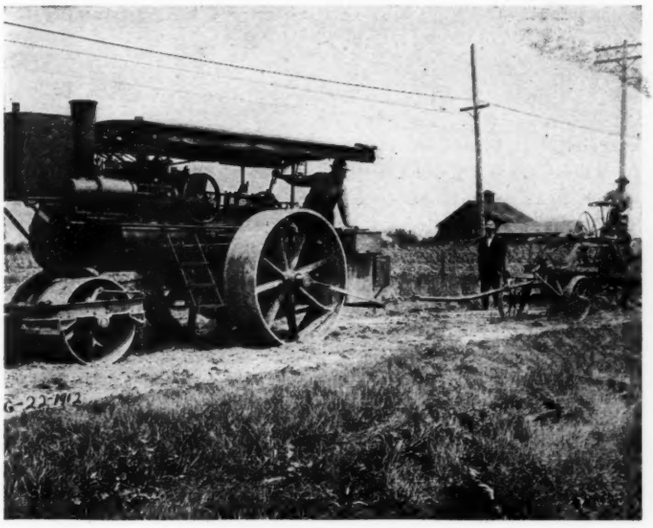
Of course, it is not necessary to turn the engine around, as it pushes as well as pulls the load. The average train consists of 30 loaded cars, on a level road, and 9 only where the grade is 6%, though as many as 42 cars have been hauled.

Unloading and Piling Materials.

Materials for the work begin to arrive before actual concreting is in progress. These are immediately unloaded by a

clamshell bucket and thrown into stock piles. After concreting has been in progress, the materials are unloaded directly from the railroad cars to the steel dump cars and transported to place. The unloading crew consists of four laborers, an engineer, and team and teamster. The team hauls seven loaded cars to the siding where trains of 30 cars are made up. Whenever shipments are delayed the stock pile is resorted to for materials. Work usually is started at the end farthest away from the railroad switch. Five miles per hour is the average set speed, including time for coaling and watering. The actual running speed en route is from 6 to 8 miles per hour.

There is no danger of dumped materials falling back upon the track, as the center of the pile is about 3 ft. from the edge of the nearest rail. Two men are able to tip a loaded car body. Materials are readily measured in the cars and distributed along the road at such intervals as best to meet



GRADING BEHIND AN ENGINE ALSO SERVES TO ROLL THE SUB-GRADE, WAYNE COUNTY, MICH., CONCRETE ROAD CONSTRUCTION.

the requirements of the mixer. The aggregates are loaded into the dump cars, the cement in any available cars, and expansion plates, asphalt filler and other necessities on the flat cars. Coal for the mixer is likewise brought to the site over the railway. As concreting progresses the haul becomes shorter and the track is taken up. These rail sections are transported to the loading point on the return trips of the train.

Industrial Railway Gives Satisfaction.

The tracks for the industrial railway can be laid on any surface over which transportation of any kind is at all possible. Rainy weather and muddy roads do not impair the efficiency of rail haulage, nor is the load too heavy for the ordinary highway bridge. A factor of much importance is that very little hauling space is required. When necessary the track can be laid on the berm of the road, so that it is possible to haul material either in the same direction as the concreting is proceeding or else in the opposition direction. The railway, too, is practically independent of labor conditions, as one engineer, a fireman, and two or more brakemen make up the entire crew. Although the unit rail sections provide an easy method of crossing highways and steam and electric lines, and the clearing of these when necessary by removing the rail sections, it is not always possible to obtain permission to make such crossings.

Where the use of an industrial railroad is not feasible teams are used for hauling. Teams work economically on short distances, but weather conditions at times are a handicap, and at certain seasons of the year the demand is so great for them generally that they are difficult to secure.

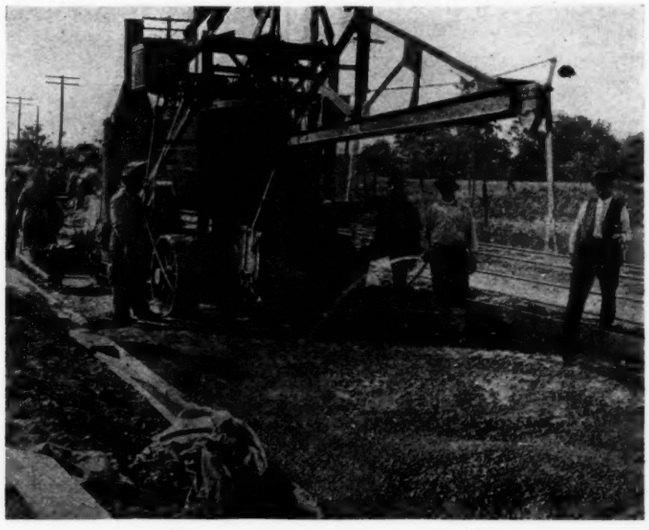
Distributing Materials

One man on the grade has charge of the dumping of material and he is furnished with a table of materials to be placed per 100 ft. stations, in order that the material may be properly placed to minimize rehandling.

The foreman in charge of the yard is also furnished with a table of quantities showing amounts required on different widths of roads so as to avoid surplusage at a given point.

Stock piles are also established in the fall at various unloading points so that breakdowns, car shortages, intermittent or irregular deliveries will not interfere with the work after getting under way in the spring.

During the past year long hauls have been encountered



SPRINKLING SUB-GRADE PREPARATORY TO PLACING CONCRETE

very generally. On the Seven Mile Road the farthest point of haulage was over nine miles; on the Mack Road the farthest point of haulage was about seven miles.

Water Supply.

The transportation of water, of which large quantities are used in mixing and curing concrete, and supplying the mechanical equipment, such as concrete mixers, traction engines, road rollers, etc., has often been a serious problem. It has been solved by laying 2-in. pipe along the road from the nearest source of supply, and pumping the water along the route, either by gasoline engines or electric motors. Water has been pumped a distance of 10 miles, the nearest source of supply, and water piped from the water works system of Detroit, Northville and other cities and villages.

Road Design.

The standard width is now concrete 18 ft. wide with a minimum width over all of 28 ft. The concrete is 6 in. thick at the sides and 8¼ in. thick in the center, built on a flat subgrade. Six inch channels 12 ft. long are used instead of wooden forms along the side. As these forms are subsequently used to support the templet and bridge from which the finishers work, great care is exercised to get them true and rigid. Expansion joints consisting of asphalted felt (about ½ in.), inserted between two Baker Armor Plates, are placed in the road 25 ft. apart.

Concrete Mixing.

A concrete mixer which travels under its own power is

used, from which a 20-ft. boom projects, which swings over a 180-degree arc. The dumping bucket is carried out on this boom under power, and eliminates much hand labor. One batch consists of three sacks of Portland cement, 4½ ft. of sand and 9 ft. of pebbles. The specification that the batch

LOADING INDUSTRIAL CARS WITH CLAMSHELL.

shall receive 16 complete revolutions and remain in the mixer for one minute is resulting in producing an excellent quality of concrete. Batches are discharged at intervals of about two minutes. The 10-hour working day is observed.

Concreting Materials.

Before any concrete is placed, in order to prevent absorption of the water from the mixed material, the subgrade is thoroughly wet down. The mix is fairly wet and of such consistency that men working in the concrete sink 4 or 5 in.

HAULING CEMENT UP 6 PER CENT. GRADE ON INDUSTRIAL RAILROAD.

Clean material is an absolute requisite to securing good concrete. The pebbles are washed and screened so as to be free from loam, clay and other foreign substances. They range from ¼ to 1½ in. and are so graded as to reduce the voids to a minimum. The sand is bank sand, washed and screened, free from loam, clay, etc., and ranges in size from ¼ in. to dust, with the coarser particles predominating. The bulk of the coarse and fine aggregates are shipped in from outside points on account of their scarcity locally.

Placing Concrete.

When the mixer is close to the stock piles, congestion is avoided by having six men load the barrows and six men wheel the materials to the skip. Wheelers and shovelers alternate in their work for each successive block of concrete, a scheme that has proved efficient, because the variety of work tends to prevent its becoming monotonous. When the stock piles are a relatively great distance from the mixer, each of the twelve material men loads and wheels his own barrow, so that a continuous stream of material is always en route.

Use of Templet

The concrete is brought to grade and shape by the use of a templet. This templet or strike board is made of 2-in. plank, preferably in a single piece, the curvature of the under edge being made to conform exactly to the finished surface of the concrete road, which is crowned approximately ¼ in. to the foot. On each side of each end is an iron handle for drawing the strike back and forth. The curved edge is shod with 1-in. angle irons bent to the curvature of the strike, giving it a metal wearing surface. The length of the strike exceeds the width of the road metal by 1 ft. A 12-in. plank is suitable for widths of road metal up to 18 ft. If the road is wider than this, a built-up form of strike is necessary, which is trussed to prevent a sag or flattening of the crown. The strikeboard is sawed back and forth on the side rails, and moved slightly forward at each stroke, giving the concrete its initial shape. After this operation no workman is permitted to disturb the concrete in any way either by stepping in it or by throwing anything upon it. This rule is imperative, as a violation of it means a road with waves and depressions by causing the neat cement and finer particles to rise to the top. The aim is to have the stone take the wear, as it is the hardest part of the aggregate.

Finishing

The final finishing up of the road is done by two men whom we term "floaters," who work from a bridge which

MATERIALS SPACED ON GRADE READY FOR MIXER.

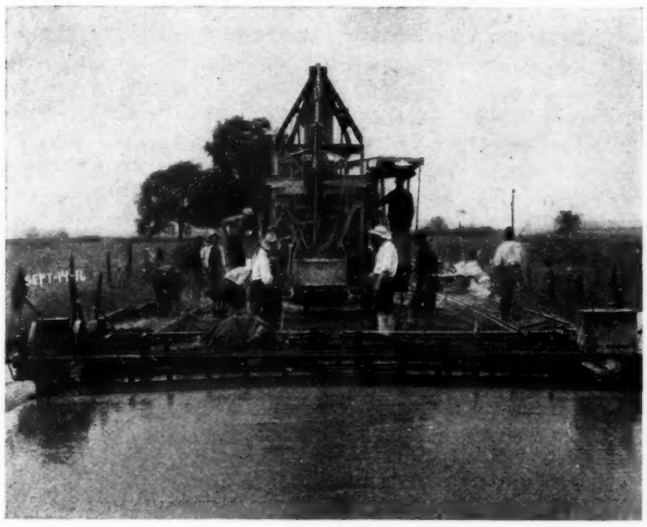
rests on the side rails, having no actual contact with the concrete. A wooden trowel of home manufacture is used for this purpose. The use of a trowel of this nature prevents the road from becoming slippery.

One crew used a finishing machine during the entire season, for shaping and finishing the road, with very satisfactory results as regards the quality of work produced, but up to date the cost has been greater. The better results secured

in eliminating depressions and irregularities, however, justifies this small increase in cost and the board will undoubtedly add this device to their standard mechanical equipment.

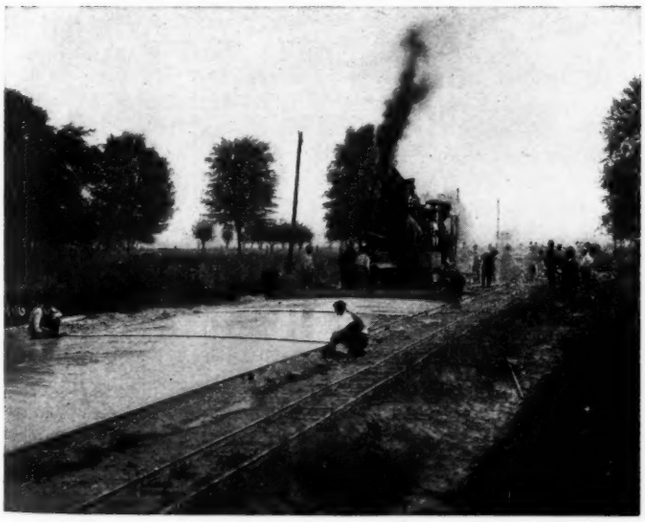
Curing Concrete

When the concrete will stand of its own weight, the side rails are removed. Each day's work is finished up to an ex-



FINISHING MACHINE STRIKING OFF, FLOATING, LEVELING AND FINISHING SURFACE ON AN 18-FT. WAYNE COUNTY CONCRETE ROAD.

pansion joint, and no more than 20 minutes is permitted to elapse between batches during the day. The day following the laying of the concrete it is covered with a couple of inches of sand or loose soil such as is available and is sprinkled during the day for two weeks. This prevents the road from drying out and is an important factor in properly curing the concrete so that it will attain its maximum hard-



FINAL FINISHING WITH A CANVAS BELT ON WAYNE COUNTY CONCRETE ROADS.

ness and strength. Plenty of water after initial set has taken place is vitally essential in producing good concrete. The finished road is sprinkled continuously for at least two weeks.

Roads are not opened for traffic until from four to six weeks have elapsed after the last batch of concrete is laid; the length of time depends upon the season of the year, as concrete sets up much more slowly in cold weather than when it is hot and dry.

Shoulders of earth or crushed stone or gravel, are built 3 to 4 ft. wide on each side of the concrete. This work is not started until after the road is at least four weeks old.

During the past year most of the work has been carried on well away from towns where suitable quarters could not be obtained for the men, so sleeping and eating quarters in tents along the road were provided. The men obtain food from the nearest town and cook their own meals, while the water supply for the roads, usually serves as well for the men. The mixer crew's quarters are kept at sites a convenient walking distance from the work, and the men unloading and transporting materials live in tents pitched close to the railroad siding.

Three concreting crews were maintained in the field during the past summer (1917), and to each of these crews is attached a grading crew, a shouldering and ditching crew, an unloading outfit and a culvert crew. All work is specialized and machinery is used wherever possible, since man and horse labor are scarce and expensive in the country districts during the road building season.

Using Home-Made Equipment on a Small Monolithic Brick Pavement Construction Job

By Fred R. Charles, Civil Engineer, Richmond, Ind.

One of the modern practices in brick paving is to make the wearing surface integral with the foundation, either by laying the brick directly on the fresh concrete or on a cement-sand cushion.

This method does not tolerate slipshod ways, but requires the very best. The former often creep in without the intent of the contractor to slight his work or "skin the job"; in fact they may easily cost him more than better methods, and come in merely through lack of watchfulness on his part or the carelessness of his men.

A street, recently built, illustrates the building of a monolithic pavement by the use of home-made equipment, and without elaborate and expensive appliances, as the job was too small to justify the expense of the latter; the contractor not being already provided with them.

The Templets

Two widths were necessary, 20 and 26 ft.; requiring two lengths of templets or "cut offs", which were made at a local planing mill of six 1-in. planks spiked together, and cut to the proper crown and notched at the ends to ride on the concrete gutters, as the combined curb and gutter with 12-in. apron was built first.

At each end of the templets runners at right angles thereto, shod with iron to prevent wear, rode the gutters and tended to keep the templet vertical. Sometimes the templet is attached to the traction mixer and is drawn when the latter moves, but in this case it was pulled by from 4 to 8 men, depending on the width and the stiffness of the concrete. Usually 2 or 3 repetitions were required to bring the concrete to the proper level.

After the passing of this first templet, a dry mixture, composed of one part cement to two parts sand, was spread on the surface and a second templet drawn over it. This templet was made to cut about ⅛ in. higher than the first, and its effect was merely to fill in the rough places and cover the concrete with a slight film of dry mortar, about like war butter on war bread.

Directly upon this the brick were laid in first-class manner, as usually specified; rolled immediately and grouted within 30 minutes.

Consistency of Concrete Mix

In mixing concrete for base, it was found necessary to use

care to guage rightly the amount of water. A little too dry would make the templet hard to draw, and leave a rough surface, while a little too wet would cause a soft spot in the foundation, allowing the brick to settle too much when rolled, and causing an uneven surface. So the concrete must not be too wet nor too dry, but must be "just right". The amount of water in the gravel aggregrate after washing or after a rain, or after several days sunshine is a variable quantity, and it requires considerable vigilance to see that the right amount is added at the mixer, for a uniform consistency is essential.

Hand Rolling

After laying and inspecting the brick, which latter should be done as much as possible before laying, in order to avoid disturbance of the bed by removal after laying, the rolling was done by a hand roller, filled with water to furnish the weight. One man could handle this roller, but usually two were put at it to obtain better speed. Rolling was first done longitudinally, beginning at the gutter and working up to the center, then at the other gutter, to the center, then across the street; then at an angle of 45 deg., both ways, making a letter "X". This generally ironed it to a smooth surface, but if not, rolling was continued until so secured.

Grouting

As soon as possible, after rolling, the grouting was done in the usual way; mixing by hand in the standard boxes; using care to obtain thorough mixing and applying without separation of the ingredients; thoroughly filling the joints by repeated brushing and squeegeeing; repeating as often as necessary to fill the joints completely after settlement.

In operation, the men wheeling concrete were utilized to draw the templet as they could easily do this and still keep ahead of the brick layer with the foundation. One additional man took care of spreading the dry mortar and shaping it with the "lute" where needed, such as at street intersections, where the regular cut-off would not work. On narrow intersections, a man with a good eye could do it properly, but on wide ones, stakes were set at close intervals by the engineer.

Two men could roll, and then help the others on the grouting. Taking it altogether a very satisfactory pavement was obtained, with a fair profit to the contractor.

Bumps and Waves in Bituminous Sheet Pavements

By W. L. Hempelman, Pioneer Asphalt Co., Chicago, Ill.

The present contribution was inspired by reading the article by Mr. Lester Kirschbraun, in MUNICIPAL ENGINEERING for March, 1918. On page 104 he shows graphically temperatures at various depths in a bituminous mixture with a constant surface temperature of 150 deg. Fahr. for five hours.

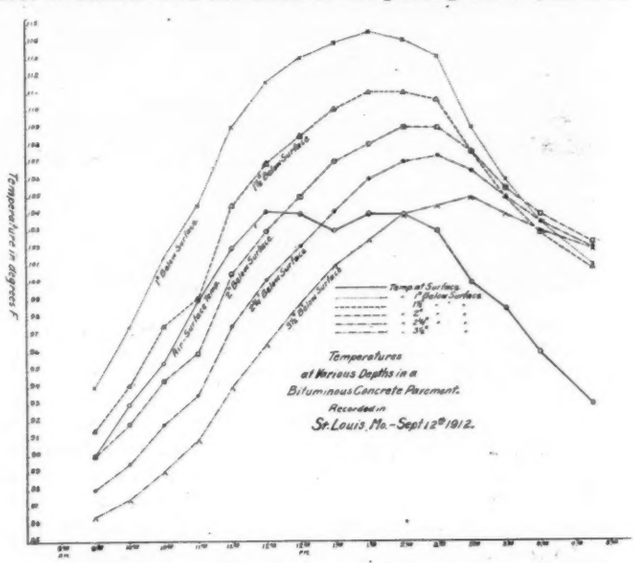
The data here given are not newly observed. In fact, they were compiled several years ago, but, in the writer's opinion, the theory here suggested, if it may be called a theory, holds now as well as it did then.

Many, many sound reasons have been enumerated in explaining the "waving" or "pushing" of bituminous sheet pavements. In specific cases frequently one primary cause has been given, the same leading to minor allied reasons, any one or combination of which might explain the particular condition under consideration.

St. Louis Conditions

As engineer of bituminous pavements for the city of St. Louis the writer had the opportunity of observing many different types of pavements as well as pavements constructed by different contractors with different bituminous materials. It was with the idea of determining if possible a condition which prevails in all bituminous pavements in a particular locality that the observations tabulated and platted herewith were made.

It was thought that, everything else being equal (the mixture, raking, depth, compression, density, etc.), there might be a sufficient difference in temperature between successive (imaginary) layers, meaning at different depths from the surface in contact with the wheel of the passing vehicle, as to result in a material change in the consistency of the asphaltic or tar binding cement for these various depths. What follows particularly applies under climatic conditions such as obtain in Missouri and other states of the central Mississippi valley. It is not uncommon in this section to experience a dry, hot spell of from five to eight weeks, during which period the atmospheric temperature may not fall below 80 deg. In other words, there is not a marked cooling off of the atmosphere with sundown, and hence the pavements do not cool to the same extent for their entire depth, as in other localities, all of which means the pavement tends to remain soft or plastic, due to the softening or change in consistency of the bituminous cement.



TEMPERATURES OBSERVED AT VARIOUS DEPTHS IN A BITUMINOUS CONCRETE PAVEMENT FROM 9:30 A. M. TO 4:45 P. M.

Temperature Variations

We all know that during the hot summer months properly

TABLE I—TEMPERATURES AT DIFFERENT DEPTHS IN BITUMINOUS CONCRETE PAVEMENT (BITULITHIC).
(Observed in Grand Ave., just South of Meramec St., St. Louis, Mo., September 12, 1912.)

Time	Air—°F	Depth of 1 in.—°F	1½ in.—°F	2 in.—°F	2¾ in.—°F	3½ in.—°F	Remarks
9:30 A. M.	90	94	91.5	90	88	86.5	Clear
10:00 A. M.	93	97.5	94.2	91.8	89.5	87.5	Clear
10:30 A. M.	95.4	101.5	97.5	94.3	91.8	89.2	Clear
11:00 A. M.	99	104	99.2	96	93.5	91	Clear
11:30 A. M.	102	109	104.5	100.5	97.5	94	Clear
12:00 N.	104.3	111.2	106.8	103	100.2	96.5	Clear
12:30 P. M.	104	113	108.5	105	102.2	98.8	Clear
1:00 P. M.	103	113.8	110	107	104.2	101	Clear
1:30 P. M.	104	114.5	111	108	106	102.5	Clear
2:00 P. M.	104	114	111	109	107	104	Clear
2:30 P. M.	103	113.2	110.6	109	107.3	104.5	Slightly hazy
3:00 P. M.	100	109.2	107.6	107.5	106.5	105	Slightly hazy
3:30 P. M.	98.5	106	105.0	105.5	105	104	Slightly hazy
4:00 P. M.	96	103.5	102.8	104	103.5	103	Quite hazy
4:45 P. M.	93	101	100.8	102.3	102	102	Quite hazy, few clouds

TABLE II—TEMPERATURES AT DIFFERENT DEPTHS IN SHEET ASPHALT PAVEMENT.
(Observed in E. S. Kingshighway, North of Berlin Ave., St. Louis, Mo., September 4, 1912.)

Time	Air—°F	Depth of ⅞ in.—°F	1⅝ in.—°F	2¼ in.—°F	3⅛ in.—°F	4 in.—°F	Remarks
10:00 A. M.....	88	86	86	86	84.5	85	In shade until 11:00 A. M.
11:00 A. M.....	94	90.3	89	87.8	85.5	85.5	Clear
11:30 A. M.....	99	102	98	93.6	88.6	87.2	Clear
12:00 N.....	101	106.5	104.3	99.5	92	89.5	Clear
12:30 P. M.....	103.2	111	108.2	103.6	96.7	93	Clear
1:00 P. M.....	104	116	112.8	107.2	100	96	Cloudy from 1:00 to 1:40 P. M.
1:30 P. M.....	101.3	114.2	112	108.5	102.2	98	Cloudy
2:00 P. M.....	104.5	116	112	109	103	99.2	Passing clouds
2:30 P. M.....	108	117	114.5	110.6	104.8	100.5	Clear
3:00 P. M.....	106	117	115.5	112.2	106.5	102.2	Clear
3:30 P. M.....	104.5	115	114.5	112.5	107.3	103.5	Clear
4:00 P. M.....	101.6	113	103.4	112	107.3	104	Clear
4:30 P. M.....	97	106	108.5	108.5	106	104	In tree shadow at 4:15 P. M.
5:00 P. M.....	97	104	106	106.2	104.4	103	Shade

constructed bituminous pavements will be marked by caulks of horses' shoes. The common thought as expressed by an asphalt foreman laying a street is that "if it does not mark in summer it will probably crack in winter." The desirable pavement, traffic, climatic and local conditions considered, is that pavement which will not become objectionably soft in summer, and thereby materially add to the tractive effort necessary to move a given load over it, and will not become glassy hard in winter, resulting in a dangerous, slippery pavement. Consider the possible temperature variation of such a pavement, say, for St. Louis conditions. On the surface of an asphalt pavement in St. Louis we have recorded a temperature of 142 deg. F. and in less than six months a temperature of 4 below zero. The loads carried by these pavements, the impact of the horses' shoes, etc., were the same for both temperature conditions. With a possible temperature variation of approximately 145 deg. we were frequently asked in St. Louis why the pavements were not constructed so they would not mark in summer.

One particularly hot afternoon in August, in St. Louis, a thermometer with the bulb just covered with asphalt lying on the top of a barrel of asphalt reached a temperature of 152 deg. F.

Method of Taking Temperature

In recording these temperatures a word should be said concerning the method employed in obtaining the data. Holes were drilled in the bituminous pavement and thermometers inserted, depths indicated being the distance the end of the thermometer penetrated below the surface of the pavement. A mixture consisting of sand and a heavy flux oil was packed about the thermometer from the bottom of the opening to the pavement surface. As indicated, readings were taken every 30 minutes for a period of 7 hours. To the right, under remarks, we attempted to describe the atmospheric conditions at the time reading was taken. As was expected, we found the atmospheric temperature in the morning to be considerably higher than at any material depth in the pavement, which condition, it will be noted, entirely reversed itself by 5:00 p. m. The platted results most clearly show this.

Conclusion

With the difference in temperature for the different depths, as indicated, it would seem that the change in consistency of the asphaltic cement for these different depths might easily permit the shifting of the wearing surface material on itself. This would particularly obtain where the bituminous cement used was of a susceptible nature—that is, a material which changes decidedly in consistency for slight changes in temperature.

Only Table I has been represented graphically, since from the recorded data it will be seen that the curves for Table II would be very similar.

As might be expected, the maximum temperature reached for any depth becomes later in the day as the depth increases. It will be interesting to note that while the highest atmospheric temperature in the sun was 106 F., in Table II this temperature is exceeded by the maximum temperature for the various depths, the temperature for ⅞ in. below the surface reaching 117 F. To the writer it seems the bituminous pavement assimilates heat during the day, part or all of which heat is lost during the night. The temperature at any depth in the pavement in the morning will depend upon the atmospheric temperature change which has taken place and the condition of the air, whether quiet or windy.

Recommended Procedure in the Construction of Wood Block Pavements

By Lambert T. Ericson, Assoc. Mem. Am. Soc. C. E., Contracting Engineer, The Jennison-Wright Company, Toledo, Ohio, The Midland Creosoting Company, Granite City, Ill.

There has been a decided movement on foot during the past year to eliminate sand and dry mortar cushions in creosoted wood block pavements. This plan has been extensively tried out and has proven a decided improvement over the methods formerly employed and will undoubtedly result in the prolonged life of the pavement involved.

Omission of Cushion

The methods pursued consist in finishing the concrete base with a smooth and even surface, exactly conforming to the contour of the finished grade and exactly the depth of the blocks below it. This can be accomplished, in most cases without extra expense, by the use of long-handled wooden floats or similar devices. The concrete base is then covered with a thin and even coating of coal tar pitch, which is permitted to harden before the blocks are laid upon it.

Necessity of Bituminous Fillers

Mr. Teasdale, of the Forest Service Laboratory, in an exhaustive report to the committee on "Service Tests of Creosoted Wood Block Paving," of the American Wood Preservers' Association, at their convention in Chicago in January, gave positive proof of the necessity of bituminous fillers being used and the desirability of a firm and unyielding base being provided; that success may be had with either coal tar paving oils or pure coal tar distillate oils, the essential point being that the treatment should be thorough and properly carried out. These facts have been borne out by experience in all parts of this country. The combination of sand cushions and sand fillers has always been disastrous. Proper construction methods in combination with thorough treatment will result in uniformly good work, regardless of the grade of preservative oil used.

The substitution of dry mortar for plain sand in the cushions was a decided advance, but even with that type of construction the result desired—namely, the elimination of shifting—is not always attained, on account of the frequent failure of the cement properly to set up. The full preparation of the base, in plain sight, before the blocks are placed in position, is a sure preventive of this evil, and also eliminates the possibility of pockets of water forming underneath the pavement.

Omission of Cushion Minimizes Adverse Weather Effects During Construction

Another decided point in favor of the elimination of the

cushion, from the construction standpoint, is the facility which it affords for construction to proceed in unfavorable weather conditions. Sudden rainstorms very often wash out and destroy uncompleted sections of pavements where cushions are used, and it is impossible to proceed if the weather is at all unfavorable. At the end of a season a hold-up of that kind incurs endless hardships both to the contractors and the community. The accompanying view shows paving being installed on Stickney avenue, in Toledo, Ohio, during the past winter, directly after a snowstorm. The concrete base was all prepared in this case and part of it was coated with pitch before

STEAMING SNOW FROM WOOD BLOCKS BEFORE APPLYING PITCH FILLER, TOLEDO, OHIO.

the snow came; part of the blocks had been laid, but the pitch filler had not been introduced. It was only necessary to clear the snow off with live steam in order to enable the construction to proceed with full speed and efficiency.

Function of Bituminous Filler

The necessity of a bituminous filler is just as essential for success as a substantial base. It is necessary to seal the joints to prevent water getting underneath, to cement the blocks together and to provide expansion joints between the individual blocks. In order to be sure that the filler penetrates to the full depth of the blocks and to provide a means for the prevention of buckling due to expansion, it is further necessary to adopt an open joint form of construction.

Open Joint Construction

The open joint form of construction requires that the blocks be provided with automatic means of separation, which will assure them being separated exactly the predetermined distance apart and at the same time be held firmly in that position. This separation should not be less than ⅛ in. on the sides and 3/16 in. on the ends.

Applying the Filler

Care must be taken in applying the bituminous filler that the joints be not filled completely to the top with pitch. The top inch should be filled with sharp sand. If the joints are filled flush with pitch, the subsequent expansion of the blocks will cause an obnoxious condition on the surface similar to bleeding of the oil.

Coal tar pitch is preferable to asphalt for use as a filler, since it amalgamates perfectly with creosote oil, while asphalt does not. The pitch should have a high melting point, preferably between 145 deg. F. and 155 deg. F. When of that consistency the residue left on top will chip and wear off very quickly with the traffic. Furthermore, the creosote oil in the blocks will cut the pitch back sufficiently in the joints to prevent it becoming brittle. It should be flushed into the joints at a boiling temperature, using a rubber-edged or heated metal squeegee. When this procedure is properly carried out, the film left on top is negligible. The pitch in the joints, flushed full while hot, will settle the desired inch from the top when it cools down.

The pavement should then be covered with sharp sand and kept so covered, under traffic, for a period of six or eight weeks. If bleeding conditions should develop at any later date it should be given another coating of sand.

Specified Open Joint Construction

The open joint form of construction is now being exclusively specified by a great many cities, among which are Cincinnati, Milwaukee, Toledo, Toronto, Nashville, New Orleans and Cleveland. Mr. E. W. Stern, chief engineer highways, borough of Manhattan, New York City, Mr. Walter Buehler and several other engineers discussed the merits of this type of construction and its necessity in order to avoid the evils of buckling, in the April, 1917, Proceedings of the American Society of Civil Engineers, pages 788 to 798. When it is properly carried out it is a sure cure for buckling, bleeding and excessive slipperiness.

WATER WORKS MAINTENANCE AND OPERATION

Practical Measures for Securing Greatest Economy in Utility Power Plant Operation
II—Coal and the Boiler

By Charles Brossmann, Consulting Engineer, Indianapolis, Indiana

(The first in this series of six articles appeared in the January issue.—Editor.)

About the year 1760 James Tilghman, of Philadelphia, discovered coal near his city and sent a piece of the anthracite found to London, stating that some day his mineral would be valuable. Nothing further seems to have been done until 1800, when William Morris took a load of coal from the mine, about 100 miles away, and hauled it to Philadelphia. But he could not sell it, and people thought he was foolish to buy and try to burn rocks, and said that it could not be done. Shortly after this several enterprising persons brought some coal from Mauch Chunk to Philadelphia, advertised it with hand bills, and made practical demonstrations in public, and were successful in selling it and getting orders for more coal. About 100 years later 90 millions of tons of anthracite were produced in Pennsylvania. So much for the brief history of anthracite.

Boilers Built for Hard Coal Used for Soft Coal

The seat of industry, of course, was first in the East. Boilers were made and set, as far as a limited knowledge of combustion allowed, to suit the coal in these districts. As progress extended to the West the same types of boilers and settings continued to be used and are still largely used to this day. But is the coal the same? Anthracite is largely carbon—roughly, 90 to 95 per cent.—and only a small amount of volatile or gaseous matter. Bituminous coal is largely volatile matter (around 40 per cent.), with a much smaller percentage

of carbon than anthracite. But still many insist on trying to burn soft coal in the narrow, cramped boiler setting first adopted for anthracite. Boilers are set close to the grates and filled back of the bridge wall, so that there is little combustion space. There doesn't seem to be any answer as to why so many boilers are still set as of old, unless it is the excuse that it is so easy to copy what the other fellow has done.

Hints on Boiler Setting

Nevertheless, coal of this Central and Western country requires room to burn, lots of it; in fact, it is hard to give it too much space. Pure carbon doesn't require the space for combustion that a coal which is almost one-half volatile matter does, and this you should bear in mind when you erect your next boiler. Also, don't forget that gases distilled from such coal must have something hot to ignite them, whether it be the fire itself or a hot fire brick surface. The temperature must be high enough and there must also be sufficient room to promote or allow such proper combustion. Of course, if you do not have the best kind of setting, you must make the best of your present conditions, making such changes as are possible under these circumstances. If your settings are badly designed, there is all the more reason for careful and intelligent firing and for watching the small things around the boiler plant. Do not think that you are going to slice off a great chunk of operating expense at one point. Do not think or figure too much in round numbers, but get after the fractions. Each little thing in itself must be followed up carefully and you will notice the improvement after you get at all of them.

Items Affecting Your Boiler Room Economy

Here are a few things that you can consider as your fractions that will amount as a whole to something worth while. Perhaps in some plants one or two items will make quite a showing.

Proper Draft: Damper regulation and equalization; excess air; air through grates; and, air through settings.

Proper Coal: Correct handling of coal, and thickness of fires.

Proper Grates: Area of grates for coal; baffles and brick work; efficiency of furnaces, and efficiency of boilers.

Now, whatever you do, try to keep some kind of record of the things that happen around your boiler plant, and certain fundamental truths will soon become apparent.

Watch the Draft

No doubt you have noticed that on certain days the draft on your furnace was much better than other days. Therefore, the fire burned better, brighter and brisker than on cloudy days or days when the atmosphere felt heavy. If you have not noticed this, then ask your fireman—he has no doubt noticed it. Perhaps there is plenty or more than enough draft, even on the bad, cloudy days. Then certainly there is an excess on the good days. But is there any change made in the damper regulation to cut down or increase draft according to atmospheric conditions or load conditions of your boilers?

You would not think of driving your auto winter and summer with the same carburetor adjustment, would you? In fact, you probably could not do it. But you abuse your boiler furnace efficiency simply because you won't or don't know that it should be changed to suit conditions. Only a few weeks ago I was asked to look over a boiler plant and found this very thing. Three boilers and the damper wide open and with a very strong draft, but the fireman and engineer both said they never change it. In 15 minutes we had a temporary arrangement for putting the damper in different positions and had started to cut down on the draft, carrying only enough to get proper results. After talking to the engineer and fireman, they said that they had never looked at it in this way, and promised to try it and said that they thought it was a good idea.

Excess Air Wastes Money

In this case it was important to carry the draft as low as possible, as the settings were full of openings and cracks, which admitted a great amount of excess air. Excess air, of course, will be the cause of inefficiency. We know that you cannot burn coal with just the theoretical amount of air required for proper combustion, but we do know, and it is a matter of record, that we do not need much over 40 to 50 per cent. excess air. Yet we find on analysis of flue gases in many plants excess air several hundred per cent. over what is necessary, and this several hundred per cent. is a direct loss and is actually throwing money away by heating cold air.

Locating Air Leaks

Now, it is not in the province of this article to go into everything in the way of combustion, but one great thing of importance is the excess air problem, and it is not difficult to overcome a good portion of it in many plants. Common-sense, a candle and something to stop up the cracks will work wonders. Don't stop at the visible crack, but hunt around systematically for the hidden openings. If your plant is an old one, you will probably find them. Use the candle at all cracks and see where the flame is sucked in. If it is a new plant, you may find cracks also. It depends on how well the work was inspected as it was built.

Not long ago, in a plant, I pulled out my match box in front of the owner and tried the cracks for air leakage. "Oh, yes," said the owner, "I know all about that. A man was in here and wanted to sell me stuff to cover these cracks." "Well, the sooner you do it the more you will help the coal shortage and your pocketbook," I replied.

Method and Cost of Stopping Air Leaks

You can buy prepared flexible paint that will cover the ordinary cracks over the boiler setting and that has enough elasticity to contract and expand with the setting. The cost of such prepared material will run from 2 to 4 cts. per square foot, dependent on size. One ordinary 150-h.p. boiler will require about $12 worth of material. Is it worth while spending $12 to stop that waste? If you won't do this, make up something that can be caulked into the cracks. Use waste and thin fire clay, and then paint with heavy oil paint over the whole setting for the small cracks. Use asbestos or fire clay or a mixture of the two for the large holes. Go all around the settings; where the shell joins the brick work; where the blow-off pipe and boiler feed pipe enters; go all around doors and iron work and see that doors fit tight, and you will be surprised how many holes you find. Probably this winter some of you put weather strips on your windows at home to save fuel. Why did you do it? Could you feel cold air blowing in around the window casings? This is just what is happening around your boilers, and if you were a little red devil inside the furnace and felt that excess cold air coming in, you would yell for weather strips outside. Only this air to the boiler is sucked in by the vacuum or draft and you can't feel it. So you don't bother, and, if any one speaks of it, you smile. Perhaps, after this winter's coal trouble, you may be inclined to listen. Let us hope. But don't forget the candle and wicking and fire clay or other stuff to fill the cracks. It costs money to heat cold air. If you ran a furnace at home this winter, perhaps you know it. It costs just as much to heat air under a boiler.

You say that your fireman is too busy or your engineer can't take the time. Of course. Dig into your pocket and pay a laborer for a few days to do this. Let him take his time and get it done right. It doesn't require much skill to do this. Just loosen up with a few dollars and see what you can do.

Don't blame the fireman for the cracks or excess air. Any brick boiler setting gets some cracks, and they are easily taken care of.

Other Things to Do

* * * * * * A whole week has passed. Did you get those cracks stopped up? Well, I am glad to hear it, because there are several other things still to be done, and I

hate to spring them all at once, as you have a good many other things to think of, and I know most men are forgetful about the fractions. Don't put these things off, though, and remember that he who is successful not only sees an opportunity, but seizes it.

Damper Regulation

Let's assume that you have fixed up as far as possible all air leaks and have now arranged your stack damper so that it is cut down to where it should be, and don't take for granted that it is all right. Let me relate something that happened on a boiler installation where I had been engaged to have a new boiler placed in an old plant. We placed it next to the old boilers; everything was set up, as we thought, right. And it was. The old boilers had an automatic damper regulator in the breeching, and when the new boiler was started I was away, and was called on the 'phone and advised that they could not carry any load. The engineer pointed to the fire, saying the fire was all right. There was something wrong in the setting. It was too high, for one thing, he said. (The boiler shell was 8 ft. above the floor.) We put on the draft gage and tried it at various points, and found that the damper regulator was connected up backwards—and it evidently had been operated in this manner before we placed the new boiler. How they operated properly I do not know, but after we changed it we ran a test and ran this small new boiler at an average load for several days at 147 per cent. of rating, and at times 200 per cent. of its rated load. This was a small return tubular boiler.

SUGGESTIONS FOR FIREMAN

Break all Lumps of Coal so they are not Larger than your Fist.

Fire One Side of Furnace at a time, so that the Hot Side will Burn the New Gases.

Spread the Coal as it Leaves the Shovel. Don't land it All in a Heap.

Fire Little. Fire Often. Use only a Few Scoops at a time.

Don't allow Holes to form in Fire. Keep Fire Even and Level.

Don't allow your Fire to Burn Down Dull before Firing.

Keep your Ash Pit Bright. Don't allow Ashes to Collect.

Watch your Draft. Don't carry an Excess of Draft, and Regulate Damper at Stack to Suit Conditions.

Keep a Record of what you are Doing. Coal Burned Daily, etc.

Ask to have Scales to Weigh Coal, and a Draft Gage to Watch Draft.

Turn in some kind of a Report, so that when you Improve Conditions it will be Noticed.

Use your Head as well as your Arms.

Now, at another plant complaint was made that the coal consumption was too high. This plant had a good, high stack and lots of draft. The damper was found wide open, and simply by cutting down on the draft at the stack damper a saving of from 7,000 to 8,000 lbs. of coal per 24 hours was made. So that these two examples prove that there is something in damper or draft regulation.

Fire One Side of Furnace at a Time

No doubt you have provided means for fixing the damper at any desired point, and have placed it so it will pull the load and still be shut as far as possible. You have also stopped the air leaks and this has further improved your draft, and no doubt you have noticed it. But what about your fires? If they are hand-fired, probably some improvement might be made.

Here is an instance. One man had three boilers and six fire doors. He starts at the left—fills at each door as high as he can, progressing toward the right. To make matters worse, two of his boilers are in one setting—four fire doors with no wall between the two boilers. Think of that grate being piled up with green coal! Just like starting a new fire every time he shoveled it. I finally had him number his fire doors and then to fire lightly at doors 1, 3 and 5, and then, after an interval, to fire lightly at doors 2, 4 and 6. I explained how one side would be hot at all times, and there would be more chance to burn the gases distilled from the green coal. The hot fire on one side would help that. He would only be cooling off one side at a time.

And it makes a difference. Try it. Shovel first on one side, then alternate to the next boiler. If you only have one boiler, fire first one side and wait before firing the other side, so that one side of the fire is always hot. Keep the holes or black spots covered. Four to six scoops of coal at a time is plenty for one side. Fire lightly and often and keep your dead plate clean. Fire before you burn too low, so as to prevent holes and an inrush of cold air, and try to cover the fire when near white heat. Don't forget that a furnace is intended to be hot. That is what it is made for. Get the heat into your boiler and not out the stack. Get a thermometer and try your stack temperature to see that it is not excessive. Your firing will have to be done to suit your judgment, as different boilers require different methods, and no one can expect to be told all the little things that help take care of your particular plant. Every plant has its own little peculiarities, but remember that in every plant economy must be based on a certain foundation.

Things to Remember

Remember several important things:

Excess air—do away with it. Draft or damper regulation —watch it; not once a day, but several times a day, as the need or occasion may arise. Proper firing—*Fire light and often.* Place a sign in front of your boilers, so it won't be forgotten. Here are three things for you to study and watch, and they are three things that cause much of the loss in coal that is preventable.

Before you forget, let me suggest that you use as a little sign the accompanying suggestions for firemen. Frame it, with glass over it, so that it can be kept clean. Hang it in your boiler room, on the boiler or where your fireman can always see it, and then see that he follows it as closely as circumstances will permit.

Acting on Recommendations of U. S. Public Health Service in Improving Quality of Meridian, Miss., Water Supply

By M. L. Worrell, Manager Water Department, City of Meridian, Mississippi

In order to make this article of more value to the particular reader, so that a ready grasp of the situation may be his, it may not be amiss to describe the surroundings.

Population, Climate and Topography

Meridian, the largest city in the state of Mississippi, and the county seat of Lauderdale County, is located in the east-central section of the state, near the Alabama line. The estimated population of the city for 1917 was 32,000, of which 62 percent is white and 38 percent negro. The city is a railroad center and has a large variety of manufacturing plants, besides being the center of an extensive agricultural region. It lies in the physiographic division known as the Gulf Coast Plain, and the elevation of the city is 352 ft.

above sea level. The climate is typical of cities of like latitude, and removed from close proximity to large bodies of water. The summers are moderately hot, and frost is frequent in winter, especially the present. The average temperature for the year is 64 degrees, the mean temperature being 80 and 45 for July and January, respectively. The surrounding country is characterized by broken series of ridges and hills and ramified by an intricate system of streams and valleys; this extensive system of streams running, for the most part, in a southerly direction, affording an efficient regional drainage.

Management

A number of railroads pass through Meridian and take water for interstate carriers, local freight stations and very extensive shops, stock pens, etc., all of the railroads having contracts with the City of Meridian, which owns the water works system. The city has the commission form of government and the administration of the water department is under the jurisdiction of the superintendent of water works and public property, though a manager is employed, who has direct charge of the engineering and supervision of the water system. The U. S. Public Health Service sanitary engineer who inspected the filtration plant and catchment area said of this official: "He is an expert in his line of business, has had long experience and is fully alive to the necessity of having an unimpeachable water supply."

Catchment Area

The catchment area which supplies the water used by the City of Meridian consists of an area of about 2,200 acres, located about three miles to the southeast of the city. Of this area the city has owned for many years about 750 acres, and is now acquiring the entire ownership acting under the advice of the U. S. Public Health Service. About 80 percent of the land is wooded with pine, with a small variety of other growths, and the remaining 20 percent is partly cultivated—rather has been until recently—and partly cut-over land formerly used for grazing purposes. The soil consists, for the most part, of coarse red sand, which is poorly adapted for agricultural purposes.

Sources of Supply and Contamination

The water supply comes from three streams, fed by a number of springs, which flow in a general direction west, toward the reservoirs. At present two country roads traverse the catchment area, one bisecting the other at a point distant from the reservoir about one-third of a mile, and there is considerable traveling of country wagons, lumber wagons and conveyances of various kinds. There have been 15 or 20 houses, occupied by negroes exclusively, located on this watershed, among them being a church and lodge, where a large number of "cullud breddren and sistern" occasionally congregate. The presence of these houses, church, lodge and public roads have always proven a source of contamination of the water supply of Meridian, and while there has never been an epidemic of typhoid or other water borne disease, typhoid is always with us, the curve going up as summer begins and down as autumn wanes into winter. Investigations of the presence of typhoid in the city, with the idea of determining the possible course of infection, have not resulted in definitely fixing the responsibility further than that the most of the cases were of the "imported" order, the spread to nearby houses being attributed to flies. The typhoid bacillus has never been shown, to a certainty, in the water works water and that this has never been the real source of infection is pretty well proven by the fact of there never having been an epidemic of that disease in Meridian. That conditions on the watershed might easily lead to such an epidemic may readily be seen and for the purpose of remedying these conditions, not only in Meridian but throughout the country, the order of the U. S. Public Health Service dated Feb. 12, 1917, calling for a field survey of catchment areas and filtration plants, was promulgated. That an inspection of these conditions, with the proper remedy applied for relief, can result in much greater security for the health of any community will not be denied.

Recommendations of U. S. Public Health Service

Meridian's catchment area and filtration plant were inspected by the Public Health Service of the United States and her water supply, so far as interstate carriers use was concerned, was promptly condemned by order of the Surgeon General until we carried out, at least in part, certain recommendations which are here given:

1. The abandonment of all habitations along the water sheds of the streams furnishing water supply of the City of Meridian.
2. Closure to traffic of the roadways leading through water shed.
3. Installation of necessary apparatus which will allow for the treatment of the water supply with liquid chlorine, this being considered about the most satisfactory and easiest method of treating it.
4. A routine bacteriological examination of the unfiltered and filtered water to determine the efficiency of the filters.

With no desire to claim undue credit, each and every recommendation above listed had already been made to the present and prior administrations by the author of this paper.

Acting on Recommendations

Coming from the source of highest authority, backed by a "big stick," prompt action was had, the result being that the county authorities promptly passed an order to close the roadways within a certain time, the city began the purchase of every house site first and the wooded and cultivated lands second; the immediate installation of a liquid chlorine plant, a bond issue to pay for the extensive purchases of lands, and improvements and additions to the filter plant, the routine examination of the water to be made by the writer of this article and checked by the bacteriologist of the State Board of Health, whose methods have been approved by the U. S. Public Health Service, with frequent periodical examinations of the water by the State Board and occasional examinations by the U. S. Public Health Service through the office and laboratory of the Interstate Sanitary Officer. When the chlorine apparatus was installed—this being done forthwith after the condemnation—and treatment begun, the water was again examined by the Interstate Sanitary Officer and pronounced practically sterile, whereupon the embargo on Meridian's water supply by the Public Health Service was promptly lifted. Each examination made since has shown the same result.

The closure of the public roads has not yet become effective, due to legal delays which will soon be removed. We have not yet purchased all of the lands of the catchment area, though options have been secured and condemnation proceedings instituted against all those with whom we were unable to settle, on not a fair but an exorbitant basis, as the City of Meridian, like many other cities undergoing the same trouble, has been "held up" by the owners on account of the necessities of the case. These lands, at best worth but a few dollars per acre for agricultural and grazing purposes, have been held at from $10 to $150 per acre. We have not been able to purchase any at less than $10, though we have not paid exceeding $20 per acre, these prices not including any improvements, preferring to resort to the courts under the rights of eminent domain rather than to be robbed!"

Storage and Purification

Meridian outgrew the output of the springs several years ago and had to resort to larger storage reservoirs several

times until we now have a storage capacity of half a billion gallons and covering about one hundred acres, these reservoirs being located at the lower end of the catchment area. Natural sedimentation takes place within these reservoirs as they are, combined, about one mile in length and of varying depth, 2 to 30 ft. The water flows by gravity to the pumping station and filtration plant, located within the city limits and distant 8,000 ft., where it is treated with filter alum and hydrated lime in the usual manner, passed through a typical settling basin and on to the filters, still by gravity, and into a clear-water basin, from which it is taken by pump suction and pumped direct to the consumers. The water is low in alkalinity, naturally, and unless an artificial alkali is used it loses all of its alkalinity and an acid water results, the troubles of which are well known under the head and title of "Red Water Troubles."

Salamanca Finds Gas Engines Dependable

The city of Salamanca, N. Y., recently contracted for another gas engine to meet the city's increasing power and light requirements. It is a 350-h.p. 4-cylinder Bruce-Macbeth unit, direct connected to alternating current generator.

This is the seventh Bruce-Macbeth engine to be installed by the city of Salamanca, the first one being installed over ten years ago. For some time a steam plant was kept in operation as well as the gas plant, but a number of years ago the steam plant was displaced altogether and all water and light service furnished by gas.

The unit now being installed is arranged so that it can be operated either with gas or coal, in conjunction with which a gas producer has also been contracted for, which will automatically produce gas from coal.

SEWER DESIGN AND CONSTRUCTION

Present Tendencies in Sewer Construction and Design

By H. K. Barrows, M. Am. Soc. C. E., Consulting Engineer, 6 Beacon St., Boston

The past year has seen the formal entry of our country into the great war. We are facing unprecedented conditions and requiring billions of dollars for war purposes and supplies. This has already resulted in the national control of the great essentials—food, fuel and transportation—and we are face to face with conditions which prohibit any construction which is not urgent.

The cost of materials for sewer construction was already at an approximate maximum early in 1917 and the year has seen in general no considerable further increase in cost, but rather more difficulty in obtaining materials promptly owing to freight embargoes and delays. Labor costs have steadily increased, however, owing chiefly to war demands, both direct and indirect, and conditions have become such that little or no contract work on projects requiring a year or more to complete can be safely undertaken except upon a percentage (or cost plus fixed sum) basis.

Effect of Present Conditions

The effect of the present conditions upon sewer construction and planning is seen in several ways, viz.:

The work during 1917 was confined almost wholly to necessary extensions and few new sewerage systems were begun. In New England, as far as the writer is informed, there were but two new systems started, viz., at Reading Mass., and West Haven, Conn.

Marked Tendency to Use Labor-Saving Machinery

There has been a marked tendency to utilize to a greater extent in construction labor-saving devices, including trench excavators and backfillers, etc., and the continuance of abnormal labor costs will serve greatly to stimulate the development and use of such appliances.

The abeyance in construction has made it possible in some cases, however, to give more time and needed attention to the design of new works or extensions. While war demands have already been heavy on the engineer and there is a dearth particularly of men of the age who would normally be most active in construction, the number of older men and the

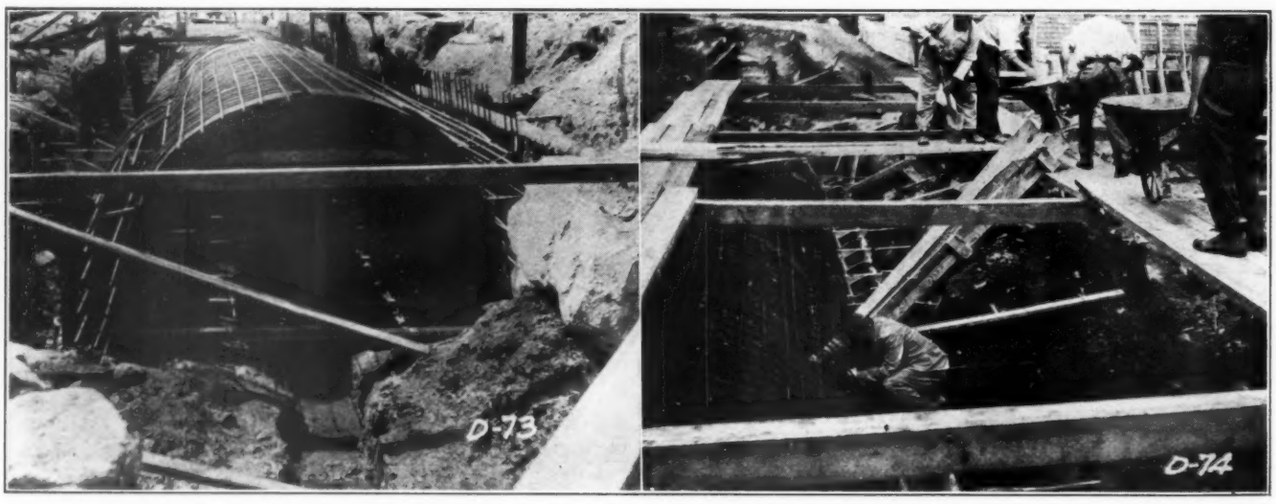


FIG. 1—CONSTRUCTION VIEWS OF 10-FT. COVERED SECTION OF FALL RIVER (MASS.) INTERCEPTING DRAIN.
Left: Forms Ready for Pouring Invert and Walls. Outside Arch Forms and Reinforcement Placed After Invert and Wall Have Set. Right: Pouring Invert Through Opening Made by Omitting Boards in Arch Form.

city and town engineers have not been as yet greatly depleted, and there is now the opportunity—badly needed in some cases—to give more attention to adequate planning and design of sewerage systems.

Trend Toward Separate System

The trend is in general strongly toward the use of separate systems of sewerage, but in many cases storm water sewers have not been given adequate study and attention, and consequently much waste has ensued and reconstruction has been required—not to mention losses from flooding cellars and buildings.

War times have brought an increased appreciation of the possible value of the by-products of sewage—grease, ammonia, etc.—and stimulated study and experiment upon processes of sewage treatment. The most notable recent contribution along this line is the "Miles Process" of sewage treatment, for which preliminary experiments have indicated great possibilities and even a profit from the sewage by-products. Obviously the success of any such process would require the use of a separate system of sewerage and the possibilities in this direction provide, in fact, a strong general argument in favor of the separate system.

Materials Used

For the smaller sizes of sewers (and up to from 24 to 30 ins. in diameter) vitrified sewer pipe is most generally used.

In some cases 30 and 36-in. vitrified pipe have been used (particularly on government contracts during the past year). As a rule, however, although convenient and quick to lay, these larger sizes of vitrified pipe are more expensive than concrete or other built-up sections. They also require great care in backfilling to avoid unequal settlement and possible fracture of the pipe due to its rigidity. Where the trench is soft the larger pipe are particularly liable to fracture and sizes over 24-in. may be undesirable.

Lock joint (concrete) pipe in sizes from 24-in. upwards also overlaps the upper portion of the field held by the vitrified pipe.

Pipe Joints

In sanitary sewers it is very important to obtain tight pipe joints, as otherwise large quantities of ground water will have to be carried and perhaps subjected to treatment, at increased cost with no resulting advantage. Furthermore, trouble is more likely to occur from roots entering the joints and clogging the pipe, if the joints are not tight.

An excellent and comprehensive discussion of sewer pipe joints was evolved at the January meeting of the Sanitary Section of the Boston Society of Civil Engineers. (See Journal of the Society for February, 1918.) Many practical results of experience were given showing progress in this important detail.

In the majority of cases discussed cement mortar joints are in use, with a growing tendency to use a poured joint—viz., of "G-K" compound (or, in a few cases, of sulphur and sand), especially in wet trenches, where the bottom of a cement joint is likely to be defective. Careful inspection is another important requisite to insure perfect joints.

Large Sewers

For larger sewers—30-in. and above—considerable latitude segmental block and brick are all in use—depending somewhat upon local conditions and, particularly during the past year, upon the availability of materials within a reasonable time.

In these days of uncertain freight deliveries, concrete has the advantage of a minimum percentage of material requiring shipment. If cement can be obtained the remaining 85% or so of sand and gravel or broken stone is usually available locally. On the other hand, the labor cost of concrete, including mixing and placing, constructing, placing and removing forms, etc., is now much above the normal and may more than offset the advantage in cost and availability of materials.

In Table I are given data of cost of concrete, from careful cost accounts, for a large reinforced concrete storm water drain built at Fall River during 1915 under the direction of the writer, under what may be called approximately normal or pre-war costs. A construction view of one of the sections of this drain, 10 ft. × 6 ft. 9 ins., is appended. See Fig. 1. For comparison are given the approximate costs based upon present prices, as well as can be estimated.

Table I—Cost of Concrete per Cubic Yard—Fall River Intercepting Drain

(Not including reinforcement.)

	——1915——		——1918——	
Item	Actual Cost per cu. yd. of Concrete	Per cent. of Total Cost	Est. Cost per cu. yd. of Concrete	Per cent. of Total Cost
Labor—				
Forms—making, placing, etc.	$2.03			
Concrete — mixing, placing and finishing	1.55			
Teaming — cement, forms, etc.	.46			
Insurance	.20			
	$4.24	45	$7.10	49
Materials—				
Lumber (forms, etc.)	.25			
Sand and stone	2.05			
Cement	2.00			
	$4.30	45	6.27	43
Equipment—				
Plant, tools, power, etc.	.93	10	1.24	8
Total cost	$9.47	100	$14.61	100

From Table I it will be noted that this work under present conditions would cost about 55% more than in 1915. Labor costs have increased somewhat more in proportion than materials, but not greatly so.

In the long run, advances in cost of labor and materials tend toward the same general percentage increase, although temporary—particularly local—differences favoring one or the other are likely to occur from time to time.

Tendencies in Construction

For more general information regarding present tendencies in sewer construction the writer addressed a circular letter to officials of ten representative cities and towns in New England late in 1917, and received replies from six, with the following general results:

The maximum size of vitrified pipe alone as used varies from 15 to 30 ins., although more commonly from 24 to 30 ins. Above 15 ins. there is some tendency to supplement the strength of the pipe where foundations are poor by using concrete.

During the past year construction work of sewer extensions on the whole has not decreased materially in amount, particularly with pipe sewers. Of six cities and towns three showed either about the normal amount of work, or some increase, and three a decrease in amount.

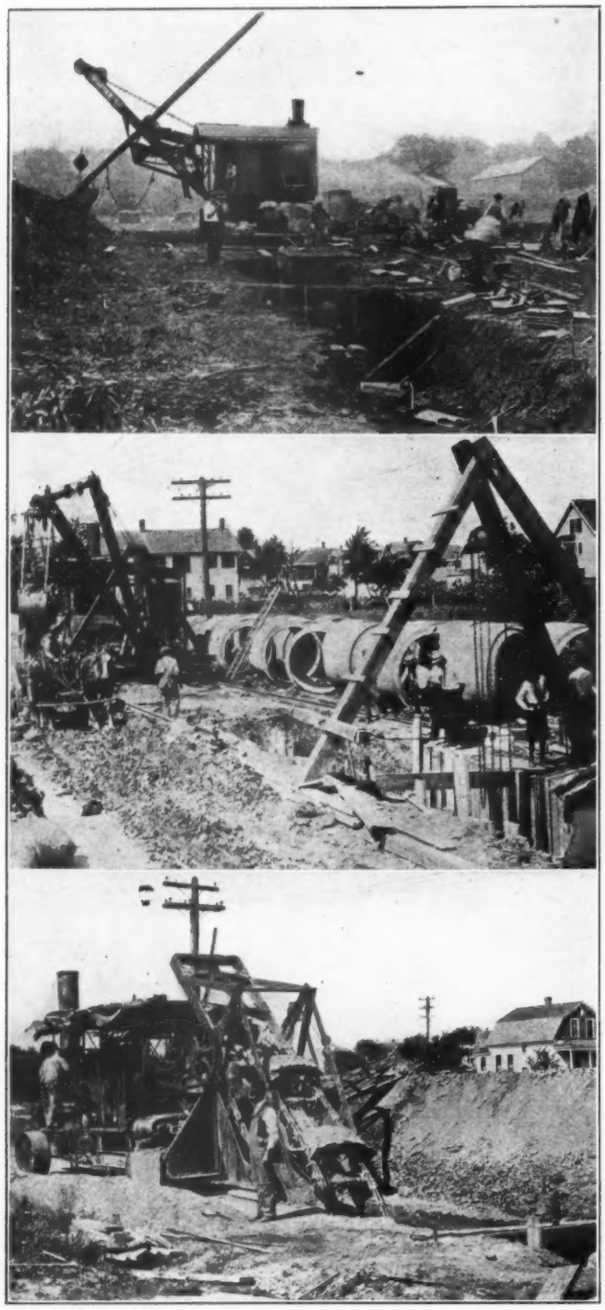
Costs have, of course, been invariably grater than normal. Materials varied from a 10% to 100% increase and labor from a 15% to 100% increase, according to the opinions expressed.

For the larger sewers concrete—plain and reinforced, segmental blocks, lock-joint pipe and brick have all been used, the amounts laid being about in the order given.

Of the six cities and towns, four have used some kind of trench machine, varying from the ordinary clam shell bucket

and derrick to various types of excavators and backfillers.

The work done at Hartford, Conn., in the last two or three years well represents construction tendencies, and through the courtesy of Mr. Roscoe N. Clark, M. Am. Soc. C. E., City Engineer, the writer is able to present herewith construction views and notes regarding work upon sewers. This is all contract work, and for sizes which have varied from 30 to 60



VIEWS ILLUSTRATING USE OF LABOR-SAVING MACHINERY ON SEWER CONSTRUCTION.

Fig. 2—Thew Steam Shovel Operating in Conjunction with Gasoline-Driven Air Compressor for Rock Drills in Sewer Excavation. Cut 7 to 20-ft. Fig. 3—Fogarty Excavator Digging Sewer Trench from 13 to 16-ft. Deep. Fig. 4—Austin Trench Machine on Sewer Cut Ranging from 8 to 11-ft.

ins. bids have been received upon plain concrete, segmental block and lock-joint pipe, with the result that in the majority of cases the segmental block has been used.

Fig. 2 shows a section of segmental block sewer (30 ins. to 60 ins. in diameter and about a mile long), built through farm land recently cut into building lots. After construction the sewer was backfilled by hand to a depth of about 2 ft. and the remaining fill done with a Thew shovel. Depth of cut, 7 to 20 ft.—plenty of room and no pipes encountered.

Fig. 3 illustrates the use of a Fogarty excavator, with lock-joint pipe, with spoil handled by teams and sheeted trench—13 to 16 ft. deep.

An Austin trench machine (Fig. 4) was also used on some 2½ miles of segmental block sewer and 8 to 11 ft. cut, with good progress, particularly where no sheeting was required. On this same work an Austin backfiller was also used.

Various other trench machines have been used at Hartford, including the Carson, Parsons and Moore.

The use of trench machines for economy in construction is now a matter for careful consideration where any considerable amount of sewer construction is contemplated. The immediate or operating cost of handling material is greatly lessened where conditions are at all suitable for the use of such a machine. Furthermore, there are several good types on the market which are already well developed and which in the light of practical use are being steadily improved. In estimating the cost of using such a machine a liberal allowance to cover fixed charges and repairs should, of course, be made. A depreciation of 25 to 33% per year is advisable to use in making such estimates, and as with all other large items of construction plant cost, such a machine must be kept at work in order to pay for itself.

For the coming year, where large sewers are to be constructed, local conditions as affecting the cost and possibility of obtaining different kinds of materials as well as labor, must be given much more than the ordinary amount of consideration by the contractor and engineer.

Procedure in Construction of Lock Joint Sewer Tile

The production of lock joint sewer tile was the manufacturer's solution of the problem stated by the engineer, who called for a sewer material with all the good qualities of vitrified, salt-glazed, sanitary sewer pipe, yet suitable for use in sewers of large diameter. Until this tile was produced engineers specified either brick or concrete for large sewers. The tile is now so well established as a dependable material of construction that it is included in the specifications of nearly all the large cities throughout the country.

Lock joint sewer tile has been developed to its present design under service conditions. First, the single ring segment block was put on the market and it met with the approval of engineers. Next, came the double ring or two-piece block, which was made for sewers from 30 to 144 ins. in diameter. The two-piece block is more to the engineers' liking as it makes a water-tight sewer. This is due to the double wall construction as there is ¼-in. bed of cement mortar between the inner and the outer block and the blocks overlap one another for a distance of about 9 ins. This construction makes it almost impossible for water to seep through at the joints.

Laying the Tile

When laying segment blocks in a dry ditch the contractor shapes his ditch to the outside diameter of the sewer. He sets up a wood templet about 20 ft. from the start of the work and stretches lines to correspond to the width of the outside blocks and then starts the outside course with half blocks (or 9-in. lengths), thus causing an overlap of 9 ins. between the inner and outer block. He lays the outside block up to the spring line and then goes back and covers the inner surface of the outer block with mortar and then lays the inside block.

To turn the crown of sewer, the contractor uses a wooden form of curvature to correspond to the inside diameter of the sewer. The form is from 5 to 15 ft. in length, as the contractor desires, for some contractors prefer a long form to save time.

In a wet ditch a patent steel templet is used to lay the outside course of block. This holds the blocks to the true diameter of the sewer and gives the contractor a chance to backfill behind the blocks.

On segment block work the ditch can be backfilled as soon as blocks are laid. Some contractors use the revolving steam shovel and backfill as they progress with the sewer.

Specific Examples

A 36-in. segment block sewer was put in at Elmhurst, Ill., last fall and the contractor was able to lay 165 ft. of completed sewer in one day with a gang of 8 men. On a 60-in. sewer at South Bend, Ind., the contractor put in 100 ft. of finished sewer with a gang of ten men, thus bringing the cost of laying the block below 1 cent per inch of diameter per lineal foot of sewer. A segment block sewer was put in at Davenport, Ia., this winter on which the contractor worked nearly the entire winter. He averaged more than 50 ft. a day on 54 and 48-in. diameter sewer in the coldest winter in recent years.

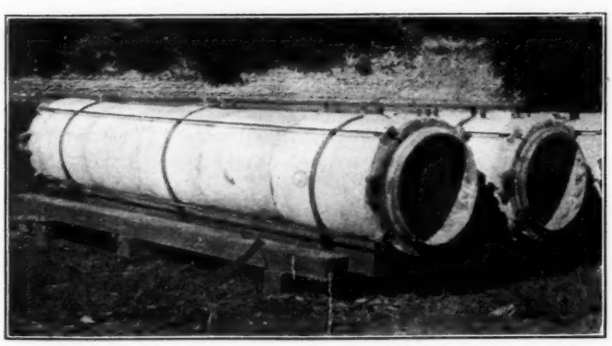
Construction of the Precast Reinforced Concrete Submerged Sewer Outfall at Lakewood, Ohio

There was recently put in service a reinforced concrete pipe outfall sewer at Lakewood, Ohio, that is laid under the water of Lake Erie. This line is laid just east of where Rocky river empties into the lake, and carries the treated sewage from the Imhoff tanks recently completed to take care of the sewage of the city of Lakewood. This line is the first built of its kind.

The outfall from where it connects with the land section to the outer end is 1,500 ft. long, consisting of 1,100 ft. of 36-in. pipe and about 200 ft. each of 30-in. and 24-in. pipe, with 4-in. holes about 9 ft. on centers, through which the sewage is diffused. In case the flow becomes too great to pass out through these holes, there is provided a flap valve with weights on the end pipe.

The Pipe

The pipe for this line was manufactured at a plant established near the freight yard of the Nickle Plate railroad at Rocky river. It was made in short sections and hauled to the water's edge and assembled into 22-ft. 2-in. lengths; each section consists of three pieces of pipe 4 ft. long and two pieces 5 ft. 1 in. long. The latter have special cast iron flanges molded in, one to form the bell end of the completed long section and the other the spigot end. The spigot end casting has a groove, in which a lead pipe is placed to act as a gasket. Some of the completed long sections are here illustrated.



BUILT-UP SECTIONS OF 36-IN. PRECAST REINFORCED CONCRETE PIPE FOR SUBMERGED SEWER OUTFALL AT LAKEWOOD, OHIO.

The short lengths were assembled on timber cradles, as shown, and after being bolted together the joints between the short sections were made. The long sections were then ready to be laid. The 30-in. and 24-in. pipe were built up in the same way as the 36-in.

The reinforcement used was triangle mesh of the American Steel and Wire Company. The concrete was 1 part cement, 1½ parts sand and 2½ parts stone. The pipe was designed to stand an internal pressure of 20 lbs. to the square inch.

Placing the Sections

The 22-ft. 2-in. sections were taken out to the place where they were to be laid on derrick scows, lowered into place, and a diver connected them together on the bottom of the lake. About five sections, or a little over 110 ft., was the average length laid per day.

This work was under the direct charge of Mr. E. A. Fisher, city engineer, and Mr. R. Winthrop Pratt, consulting engineer. The pipe was manufactured by the Lock Joint Pipe Company, of Ampere, N. J., and was laid by the American Construction Company, of Cleveland, Ohio.

Design and Cleaning of Sewer Catch Basins

By George A. Carpenter, City Engineer, Providence, R. I.

Different cities have adopted different forms of catch-basins and inlets and some engineers even recommend taking storm-water directly into the sewer without any intervening basin in which street detritus may be collected. These argue that, with sufficient velocity in the sewers to carry such street dirt along, it is easier and cheaper to collect it in a few grit chambers located in the line of the sewer and remove it from there than to collect and remove it from a large number of catch-basins. In this section, however, the general practice is to build catch-basins, and these have been designed upon various plans, said Mr. Carpenter in addressing the Providence Engineering Society.

The Providence Basin

The city has one of the best types of catch-basin. Starting originally with the circular brick basin covered with a granite gutter stone and a granite head stone forming part of the street curb it later developed the cast-iron D Frame and cover for the same basin, and now uses this form exclusively. Cutting an opening through the granite curbing for an entrance for the storm-water, the walls of the basin are drawn in at the top, and it is then capped with a cast-iron frame and cover. Nothing is visible above the surface of the sidewalk except the cover and no break is made in the street curb, or in the paving of the gutter. This design affords one of the neatest and most effective basins for city streets that the author has seen. Recognizing a good thing when it saw it, the City of Pawtucket has used this type of basin for many years.

Experiments with Basins

The author has made occasional experiments with basins constructed to meet special conditions and also with basins built to render cleaning less expensive. One of these was the construction of a basin with an interior wall of soft, porous brick and a drainage space between inner and outer wall. This space between the walls was connected by a 4-in. pipe with the main pipe running from the basin to the sewer and was designed to drain the basin and produce dryer material for removal when cleaning.

The basin was trapped by a running S-trap on the main connection, just outside the basin wall, and this was protected from sticks and other obstruction by a cast-iron hood hung on the inside wall of the basin. The S-trap provided a water seal after the water in the basin itself had escaped through the porous wall.

Only a few of these basins were built, as an experiment, for it was anticipated that the porous bricks might stop up in time and cease to operate as designed. The basins continued to work as planned, however, and required no bailing of water in advance of cleaning and the material was easier to excavate. After being in service for a dozen years or more the man who inspects the condition of catch-basins reports that they are

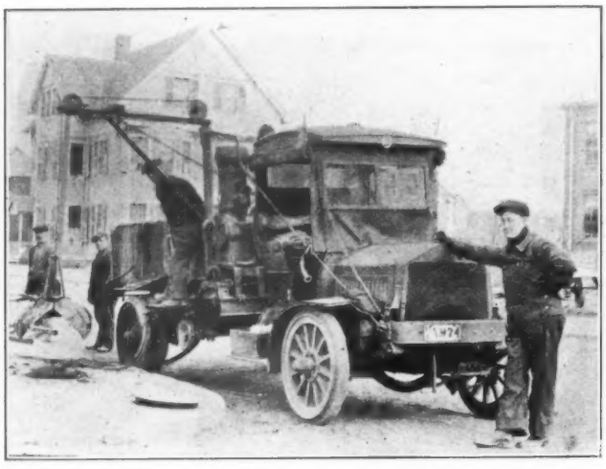
still operating as intended and that the walls of porous bricks have not become clogged.

The following credits may be given to this type of basin: There is no water to be bailed out before cleaning. The material in the basin is in a better condition to handle and cart away by the old hand method of cleaning. The basin is trapped by a small quantity of water and the water-seal is more permanent than with the hood-trap. This basin does not breed mosquitoes. If this basin is neglected and becomes filled with dirt above the hood, there is still an outlet under the hood where the water will drain off and leave the street clear.

Modern Methods of Basin Cleaning

With the modern methods of cleaning basins, however, the desirability of dry material becomes of less importance.

During the author's experience he has often had visions of reducing the cost of cleaning by the old hand method and has spent hours trying to work out some form of basin construction which would contribute to this end. His schemes have varied all the way from buckets, or tubs, in the basin, which could be hoisted to the surface when full and dumped directly into a car, to a small ladder dredge working through the cover or through a specially designed opening. All these schemes have ultimately led to the conclusion that any cleaning device, to be practicable, must be adaptable to the present form of basin, as there are too many basins in use to think of general reconstruction.



STANDARD MOTOR TRUCK EQUIPPED FOR CLEANING SEWER CATCH BASINS, PAWTUCKET, R. I.

Pawtucket Cleaning Truck

The Board of Public Works of Pawtucket has recently produced a type of cleaning truck that accomplished the object sought. In its present state it is the result of practical experience on the job, and considerable improvement has been made over the original design. Starting with a simple, self-dumping auto truck equipped with a power-operated hoist, there have been added a water pump and an orange-peel bucket at first hydraulically controlled but recently equipped with compressed air control so that the city now has a machine for the practical and rapid cleaning of basins at a greatly reduced cost.

The truck here illustrated consists of a Standard chassis with a 32 h. p. engine. On this is mounted a steel body made by the Monahon Vehicle Company of Providence, R. I., which measures about 9 ft. by 4½ ft. by 2 1/3 ft. high and has a capacity of 3.4 cu. yds. Cover plates 2 ft. wide are placed over each end to prevent the slopping of the load. The average load has measured about 2.6 cu. yds. and weighed about 3.4 tons.

The tailboard is hinged at the top, provided with a rubber gasket, and can be clamped tightly against the body. The body is provided with a hydraulic lift operated from the transmission system. A pair of 6-in. I-beams are mounted on the chassis back of the driver's seat, and on these I-beams are mounted a 6 h.p. Fairbanks & Morse gasoline engine, a cable-drum and control mechanism and an air compressor. The cable runs to an outrigger which can be swung out over the catch-basin and back over the cart after the bucket is raised and ready to dump.

The Cleaning Bucket

The first bucket provided for this truck was a plain, cylindrical one 14 ins. in diameter and 17 ins. deep with a capacity of 1½ cu. ft. It was filled by hand by a man in the basin, after the manner of the regular cleaning methods then in use. After operating this equipment from July until November, 1913, an orange-peel bucket controlled and operated by oil under a pressure of about 100 lbs. per square inch was substituted.

Experiments were made later with a bucket operated by compressed air and the improvement in operation was so great that an air compressor has been added to the equipment and the bucket is now operated in that way. These various improvements and attachments have overloaded the truck and it would be advisable to start with a five-ton truck if a new machine were to be built.

When this machine was first put in operation, with a bucket loaded by hand, its average output was 5 loads, or 13 cu. yds., per day of nine hours. With the orange-peel bucket this output was increased to an average of 7 loads, or 18.2 cu. yds., and with the addition of compressed air the average output is about one load per hour, or 23.4 cu. yds. per day.

The length of haul is, of course, a controlling factor in the work of the truck and the condition of the basin is also important. At the present time the truck is cleaning basins which are practically solid full of dry material and on this work it is averaging one load per hour with hauls somewhat in excess of one mile. With basins in an average condition the author believes the daily output can be materially increased. With the bucket averaging three fillings per minute the truck can be filled in about 20 minutes and at 7 miles per hour a trip to a dump one mile away and back can be made in 17 minutes. This should leave ample leeway to make a load, on the average of once in 45 minutes, or 12 loads per day of nine hours.

Hauls to a dump are very likely to become longer and undoubtedly will average considerably more than one mile. With a one mile haul it should be noted that it takes as long to go to the dump and return as it does to fill the truck. This indicates that there may be an opportunity for further economy in having one machine for taking the material from the basin and a separate truck for carting it to the dump.

A Money-Saving Twin-Service Carburetor

Contractors who have been paying high prices for gasoline for engines will welcome a reliable carburetor which will cut the cost of fuel from 24c to 8c per gallon.

This can be accomplished, it is claimed, with the Northwestern Twin-Service carburetor. It is guaranteed by the makers to give the operator dual control of his fuel. He may use either kerosene or gasoline. By means of a superheating attachment, introducing gas from the muffler of the engine, the kerosene is volatilized to the proper point for producing the maximum explosive power within the cylinder. There are two lead pipes from the storage tank equipped with shut-off valves, enabling the operator to draw either fuel as desired.

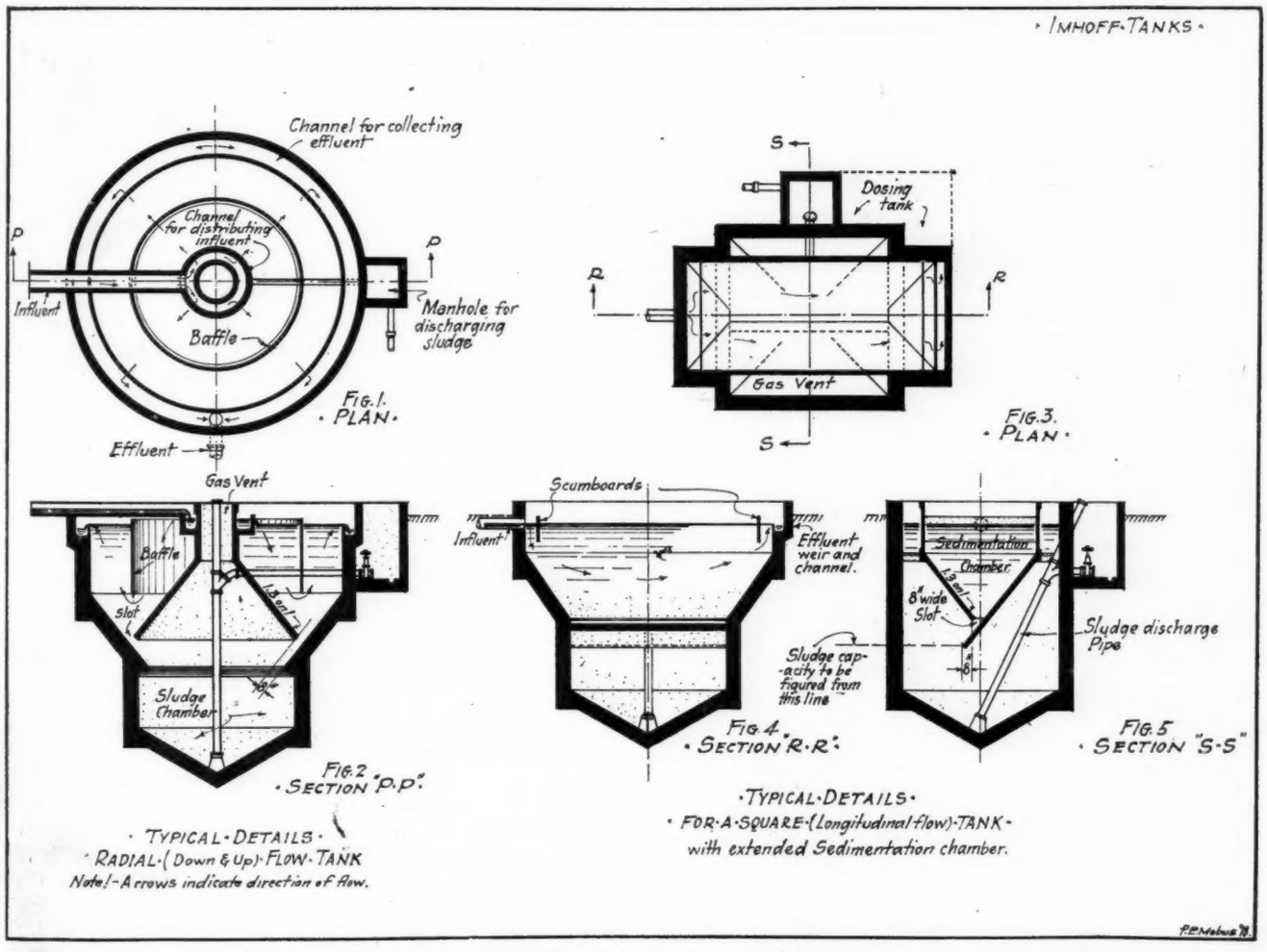
As Northwestern engines are operated with gravity feed from the fuel tank, there are no difficulties to be overcome with the many small working parts of the pump. This enables users of these carburetors not only to buy engines at favorable prices, but also to save two-thirds of the daily cost of their fuel bills.

WATER PURIFICATION AND SEWAGE TREATMENT

Specific Suggestions on the Design of Imhoff Sewage Settling Tanks

By Charles F. Mebus, of Albright & Mebus, Consulting Engineers, Philadelphia, and Percy E. Mebus, Assistant Engineer, Sewage Disposal Division Bureau of Surveys, Philadelphia.

The design of an Imhoff tank is exceedingly important, as the successful operation of the tank depends largely on the design. An improperly designed tank, even if placed in charge of skilled operators, cannot be made to produce satisfactory results. The principles of design are generally simple and readily understood. However, each installation should be carefully studied in itself and when necessary, or when deemed advisable by the designing engineer, the general rules laid down should be modified so as to secure satisfactory operation.



TYPICAL DETAILS OF RADIAL AND LONGITUDINAL FLOW IMHOFF SEWAGE SETTLING TANKS.

Radial Flow Tanks

Imhoff tanks have been designed in two general classes, one having a radial (down and up) flow and the other having a longitudinal flow. These two types are shown in the accompanying sketches, Figs. 1, 2, 3, 4 and 5, respectively. The first type generally has been made circular and the second circular, square or rectangular, the same principles applying for each case.

The radial flow type has the objectionable deep baffle hanging almost over the slots. This causes relatively high velocities near the slot when there should be a "slow motion" zone to permit easy and free passage of the settling solids to the sludge chamber beneath. This type of tank although now largely superceded by the longitudinal flow type, is still used occasionally, but is now modified by removing the deep baffle and placing scumboards only in front of the weirs, as in the longitudinal flow tanks. This shaped tank, minus the deep baffle shown, is used also as a so-called "circumferential" flow tank. A longitudinal partition is placed in the tank together with suitable baffles, so that the influent is divided into two portions, each of which must flow horizontally in a circumferential path to the outlet located directly opposite the inlet.

Longitudinal Flow Tanks

The longitudinal flow type of tank has largely superceded the radial flow type and is now considered generally better for the larger installations. The longitudinal flow type, if only one sludge chamber is used, may be made square or circular, and for United States conditions the sedimentation

chamber is sometimes made to overhang the sludge chamber in order to meet the requirements for sedimentation of the dilute sewages. In the larger tanks, the sedimentation chamber extends over 2, 3, 4 and sometimes even 5 sludge chambers adjoining one another in a single row, although 4 and 5 sludge chambers are now looked on rather with disfavor, because the sludge does not deposit equally in all of them. In still larger installations a multiple settling chamber extends over 2 or 3 single sludge chambers. In such installations the settling chambers must then be designed to be communicating in order to maintain the water level and thereby prevent the passage of sewage from one chamber to another via the sludge chamber, i. e. through the slots. When more than one sludge chamber is used, provision must be made for reversal of flow so that the deposition of the sludge in the chambers will be equalized. In the March issue of MUNICIPAL ENGINEERING, pp. 112-114, there was published an article by Mr. W. L. Stevenson, Assistant Engineer in Charge of the Sewage Disposal Division Bureau of Surveys, Phialdelphia, Pa., describing the new Philadelphia tanks and the points spoken of above were clearly illustrated in the large drawing, of the Philadelphia tanks, reproduced on page 113.

Design of Settling Chamber

The primary object to be obtained in this chamber is efficient sedimentation, and in order to accomplish this the velocity of flow must be retarded sufficiently to enable the solids to settle out and pass freely into the sludge chamber below. Good U. S. practice now calls for a 2½ to 3-hour retention period, based upon the daily average flow.

The chamber of rectangular tanks may be made either long and narrow, or short and wide, the first resulting in higher velocities and somewhat less efficient sedimentation and the second in low velocities but with greater possibilities of short circuiting of the flow, due to difficulties of securing even distribution over the greater widths. A medium must therefore be struck, which will overcome these two disadvantages.

The length of the chamber hardly ever exceeds 100 ft. and from 80 to 90 ft. is considered a good length. This then will give an average velocity of say 0.6 ft. per minute or about .01 ft. per second, which is well below the absolute maximum velocity for efficient sedimentation (usually considered as 0.1 ft. per sec.) Such low velocities will provide a factor of safety for the usual storm flows. The width of the chamber depends upon the width of the tank, which is generally determined by structural limitations, etc. As the product of the three dimensions must equal the 3-hour flow, it is necessary to adjust the width and depth. If a chamber is too shallow, higher velocities will develop in the "slow motion" zone near the slot, and if made too deep, the full cross-section will not be efficiently utilized. In 9 of the largest representative U. S. installations the depth from the flow line to the slots varies from 10 ft. 10 ins. to 13 ft. 6 ins., the former being at Rochester and the latter in the new Philadelphia tanks just designed. This latter seems to be about the maximum depth consistent with good operative requirements.

Partition Walls, Slots and Overlaps

The minimum slope of the partition walls, (see Figs. 2 and 5) should not be made less than 1.2 vertical to 1 horizontal, the writers' practice being to make the angle with the horizontal vary from 52 deg. to 54 deg. (1.28 to 1 and 1.37 to 1) depending on conditions. They should be finished smooth in all cases. These walls have been made of precast concrete slabs, monolithic concrete, "gunite" slabs and wood, all of which have proven successful. The width of the slots varies from to 6 to 8 ins. and even 10 ins., although 8 ins. seems to be generally preferred by U. S. designers. The net overlap of the slot (see Fig. 5) should be at least 8 ins., although 10 to 12 ins. is decidedly better. There does not seem to be any advantage in going over 12 ins.

Inlets and Outlets

For a single tank, undoubtedly the best inlet is a single or possibly two ports, while the outlets in all tanks should be long weirs so as to minimize the fluctuation of water levels within the tank. When reversal of flow becomes necessary, the inlets and outlets must be exactly alike, and therefore have weirs at each end. In such cases again the weirs should be as long as possible and, in addition, ports should also be provided so that no deposits will occur in the feeding channels. Scumboards should be placed in front of the weirs to help distribute the sewage over the full cross section of the tanks and to retain the floating matter so that it may be skimmed off and disposed of. They should extend about 12 to 18 ins. below and from 6 to 8 ins. above the level of the sewage. They are usually made of reinforced concrete or cypress planks.

Channels

The design of the feed channels is important and the hydraulics and layouts for each case should be carefully studied. Velocities should be at least 2 ft. per second to prevent deposit. If there is insufficient gradient to produce this velocity it will be necessary to flush the channels during operation. Suitable stop planks or gates sliding in cast iron grooves should be properly placed to facilitate operation. All corners in channels should be rounded to avoid "dead places".

Sludge Chamber

Good U. S. practice calls for a sludge chamber with provision for holding from 6 to 8 months' sludge accumulations depending on climatic or other conditions. The chamber is either square or circular as the case may be, with either an inverted pyramid or an inverted cone forming its bottom. The minimum slopes for any element of the cone or pyramid should be 2 horizontal to 1 vertical, although the writer's practice has been to increase this slope to about 30 deg. with the horizontal, especially with square tanks. It is from the apex of the cone or pyramid that the sludge should be withdrawn, so as always to get the most thoroughly digested sludge. As to the quantity of sludge, Dr. Imhoff in 1915 recommended that the following sludge capacities in cubic feet per capita be used for U. S. practice:

	Separate System	Combined System
Small plants	2.4 (.01)	3.6 (.015)
Normal city sewage.....	1.2 (.005)	1.8 (.0075)
Sewage containing abnormal sludge-forming wastes	1.8 (.0075)	2.7 (.0113)

If we assume 8 months as the storage period (240 days) which is conservative and generous allowance, we have the figures in parenthesis as the per capita sludge production per day, for the various conditions. These figures are somewhat in excess of the old figures of .0035 for separate system and .007 for combined system as originally recommended by Dr. Imhoff. The writers, about 5 years ago, somewhat questioned these old figures for U. S. conditions and made certain investigations on sludge production at a small plant sewered on the separate system where the flow was 400,000 gallons per day. The results obtained there indicated that a figure of about .007 would be more nearly correct for separate systems under U. S. conditions. This figure was used by the writers thereafter, and practically recommended by Dr. Imhoff as shown above.

With a combined system it is essential to install a properly designed screen and grit chamber ahead of the tank in order to prevent the entry of inorganic debris and heavy grit to the tank inasmuch as such materials impair sludge digestion and clog the slots and the sludge removal pipes. With separate systems, screening is also advisable to prevent towels, shoes, brushes and similar materials entering the tanks. The clearance for screens will range from 1½ to 2½ ins. for the various conditions.

The capacity of the sludge chamber should be computed from a plane beginning at the edge of the deflector or even

possibly 6 ins. below it, which means that, during operation, the sludge level should not be allowed to rise above this point (see Fig. 5).

Sludge Removal

The sludge is removed while the tanks are in operation, by means of a 6 or 8-in. cast iron pipe extending into the apex of the hopper spoken of above. It is discharged by a differential head, which ranges from 4 to 6 ft. as judgment may dictate, the former being usually ample. The flow from the pipe is controlled by means of a valve on the end of the pipe. At Fitchburg, Mass., and in the new Philadelphia tanks, compressed air is used to remove the sludge from the tanks respectively to pipes and to channels located above the sewage level, and in which it then runs to the drying beds. A pressure water piping system should be installed for loosening the sludge on the sides of the hopper bottom of the chamber and also at the mouth of the sludge pipe.

Certain Characteristics of Some 10 Large American Tanks

The depth below the surface of the sewage of a number of the larger tanks in the U. S. ranges from 21 ft. to about 30 ft. The widths range from 18 to 40 ft., while the lengths range from 60 to 100 ft. Most of the tanks have the multiple settling chambers referred to above.

The volume of the settling chamber ranges from 30 to 50 per cent of the total volume of the tank, while the volume of the sludge chamber is about 25 per cent of the total volume of the tank. The volume of the gas vent above the slots ranges from 50 to 75 per cent of the volume of the sludge chamber, while the superficial area of gas vents ranges from 4 to 20 per cent of the top area of the tank.

These figures indicate the wide range of the designs due to the diversity of the U. S. conditions, but may help to give some idea of tank proportions.

The above figures for large U. S. tanks are from data recently compiled by the Bureau of Surveys of the city of Philadelphia, with which one of the writers is connected in the capacity of assistant engineer.

The foregoing represent, in detail, the general essential principles governing the design of an Imhoff tank, all of which have been proven by experience to be essentially correct. But, as stated before, each design and the conditions surrounding it, must be carefully studied in every particular to obtain the best results. The general arrangement of tanks in relation to each other and to the other units of a treatment plant, depends generally on topography or the amount of space available for the plant. The structural designs, especially for economy, and the development of the details for following out the above rules are matters in which the ingenuity of the designer plays a prominent and important part.

The New Sewage Treatment Plant at Xenia, Ohio

By W. J. Sherman, of W. J. Sherman Co., Consulting Engineers, The Nasby Bldg., Toledo, Ohio

The city of Xenia had a population of 8,706, according to the census of 1910, as compared with 7,301 in 1890, indicating a gain of 1,405 during the two decades, or approximately one per cent per annum. Greene county, of which Xenia is the seat, is in a rich, rolling, agricultural country, with fine, large farms and a rather sparse population, viz., 71 per square mile, as compared with 117 from the entire state.

There is some manufacturing at Xenia, chiefly shoes, paper and machinery. The business of the place is dependent largely upon the rural districts for support.

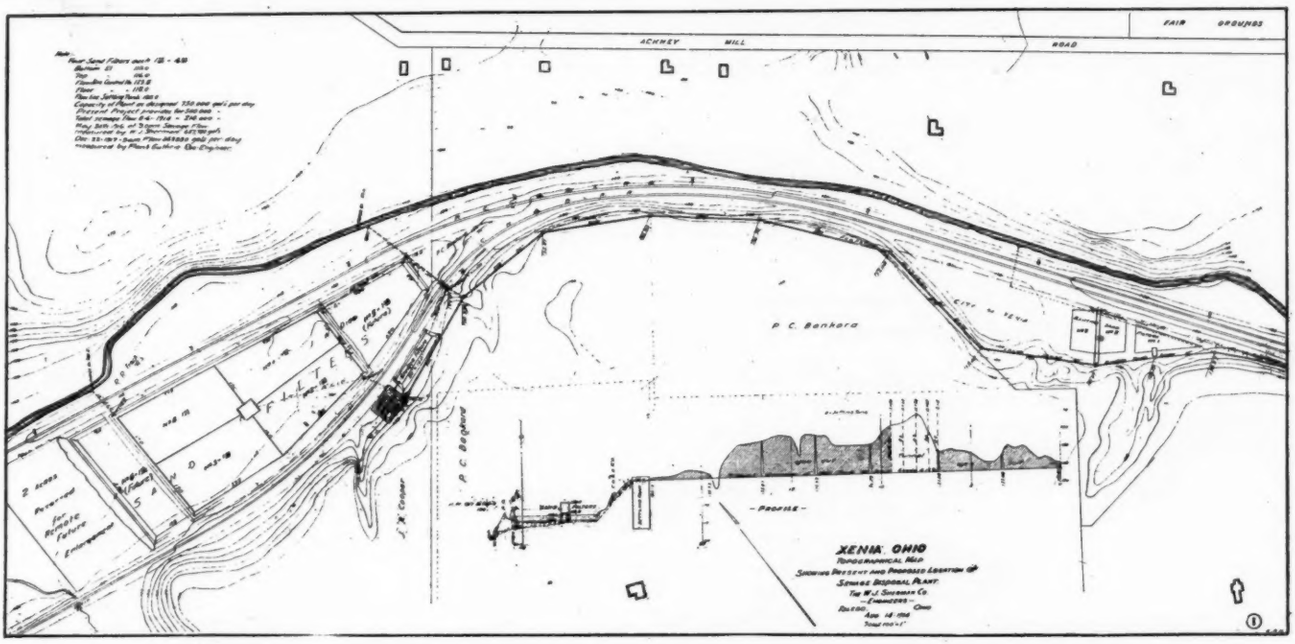


FIG. 1—TOPOGRAPHICAL MAP OF XENIA, OHIO, SHOWING LOCATION OF OLD AND NEW SEWAGE TREATMENT PLANTS.

First Sewage Treatment Plant a Failure

In 1901 a fairly complete sanitary sewer system was constructed, including a so-called sewage disposal plant, consisting of two small, shallow septic tanks with an aggregate capacity of 19,000 gals., and 1.47 acres of sand filters in four units. If well constructed, this plant should have easily cared for 185,000 gals. of sewage per day.

Poorly constructed as it was, its capacity was doubtless limited to about 100,000 gals. per day, whereas the total sanitary flow probably approximated 300,000 gals. per day. It measured about 350,000 gals. at 9 a. m., December 22, 1917.

The chief deficiency in the old filter was in the size of the plant and the next was the poor quality of the sand used in the filter beds. Besides, the installation has never been properly maintained, but, like so many similar ones, was utterly neglected by the city administrations from year to year. As a result the plant soon became a nuisance. As early as 1906 it was entirely abandoned, and in 1916 and 1917 a new one was constructed about one-half mile farther down Shawnee creek and about 8,000 ft. from the court house square. At this writ-

ing, March, 1918, it appears as though the contractor's delays, due to war conditions, would prevent putting the plant in commission before the 1st of May, 1918. The new plant is the subject of this article.

The New Plant

In brief, the new plant comprises a pair of Imhoff settling tanks, a sludge bed, a reinforced concrete control chamber and four acres of sand filters. Shawnee creek, on which both old and new works are located, has a drainage area of about 12½ square miles, a maximum flow of about 50 second feet, a minimum of 1 and an average of 4 second feet.

during the last two decades of about one per cent per annum, so there is hardly a likelihood of exceeding the capacity of the new plant for many years to come.

Details of Design

The relative locations of the old and the new plants are shown in Fig. 1, as is also the route of the extension of the main 20-in. trunk sewer from the old to the new plant. From the profile in Fig. 1 will be noted some of the construction difficulties in the sewer extension due to deep cut and tunnel work.

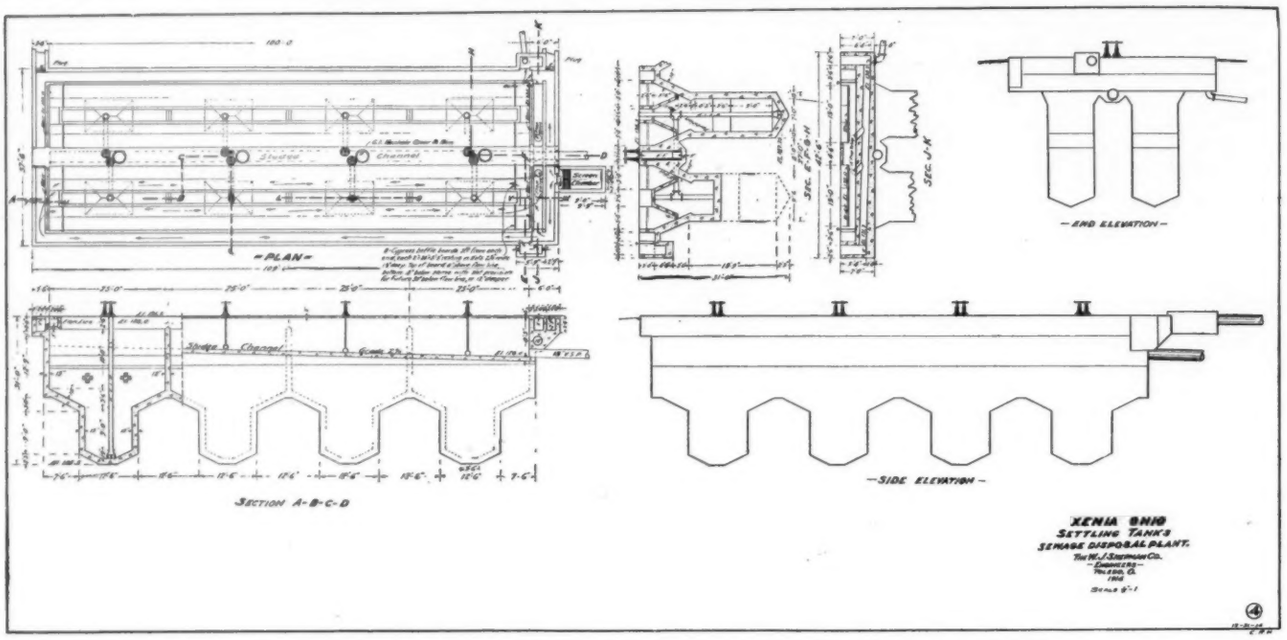


FIG. 2—DETAILS OF TWO IMHOFF SEWAGE SETTLING TANKS, XENIA, OHIO.

Fig. 2 shows a pair of settling tanks 37 ft. 6 in. by 100 ft., with eight sludge digestion chambers, screen chambers, weirs, baffle boards, channels for raw sewage and sludge, etc.

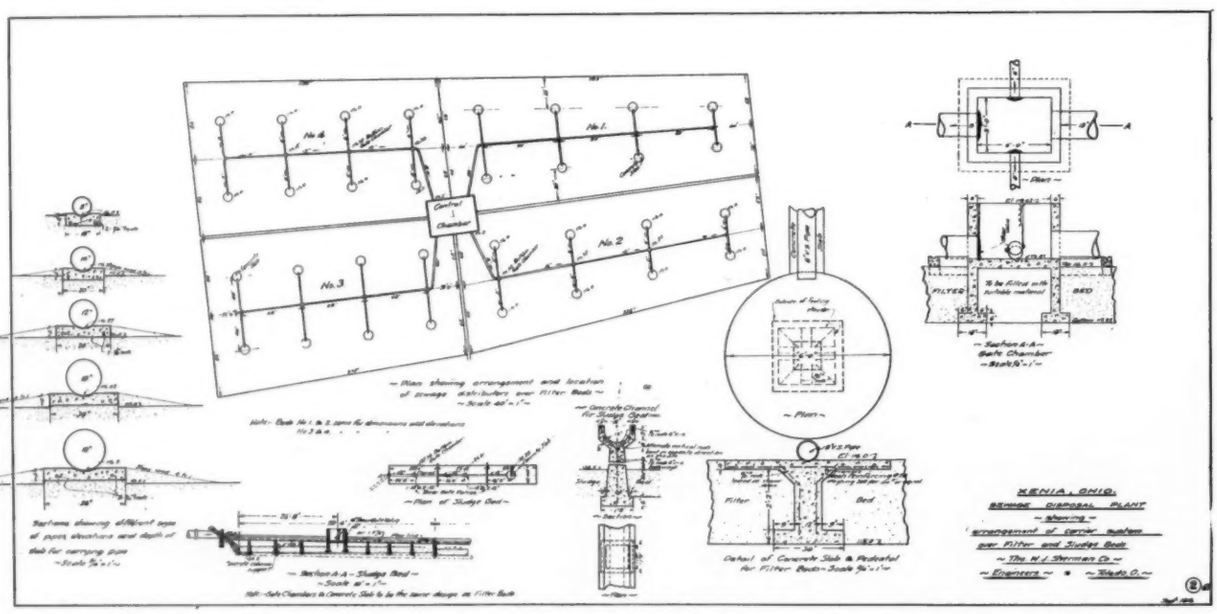


FIG. 3—ARRANGEMENT OF CARRIER SYSTEM FOR DISTRIBUTING SEWAGE AND SLUDGE OVER SAND FILTERS, XENIA, OHIO.

This plant is designed to care for a flow of household and manufacturing wastes aggregating 500,000 gals. in 24 hours, with provision for enlargement to 750,000 gals. in the future and to 1,000,000 gals. in the remote future.

We have already remarked on the slow growth of Xenia

Fig. 3 shows the arrangement for sewage and sludge distribution over the sand filters.

Fig. 4 shows the control works for the sand filters. Fig. 5

is a view of the plant as it appeared early in March, 1918.

The 20-in. trunk sewer was built of double-strength vitrified pipe and laid on a grade of 0.12 per cent. The entire plant will be operated by gravity, the topography of the land being peculiarly well adapted for such a layout.

The two-story settling tanks have a depth from flow line to bottom of sludge chamber of 27.75 ft. The upper or the settling chambers have an aggregate capacity of 8,000 cu. ft., equivalent to a two-hour detention period when treating 750,000 gals. per day, or a three-hour period when treating 500,000 gals. per day. The lower or digestion chambers have storage capacity of about 15,000 cu. ft.

Provision is made for weir measurement of the sewage as it enters the tanks.

The raw sewage is screened through ¼ by 1-in. bar screens spaced 1 in. apart.

Basis of Design

The sludge beds in three units are designed to provide an area of 0.43 sq. ft. per capita of total population, on the assumption that the volume of sludge will approximate .0035 cu. ft. per capita per day. The control or dosing chamber has a capacity of 11,000 cu. ft., with a flow line 7½ ft. above the adjacent sand filter beds. It is calculated that each dose of sewage will require about three hours for the 14-in. siphon to discharge, and that each bed will be flooded twice each day.

The specifications for filtering material call for:

24 in. of sand, 80 per cent to pass No. 20 and be retained on No. 40 sieve.

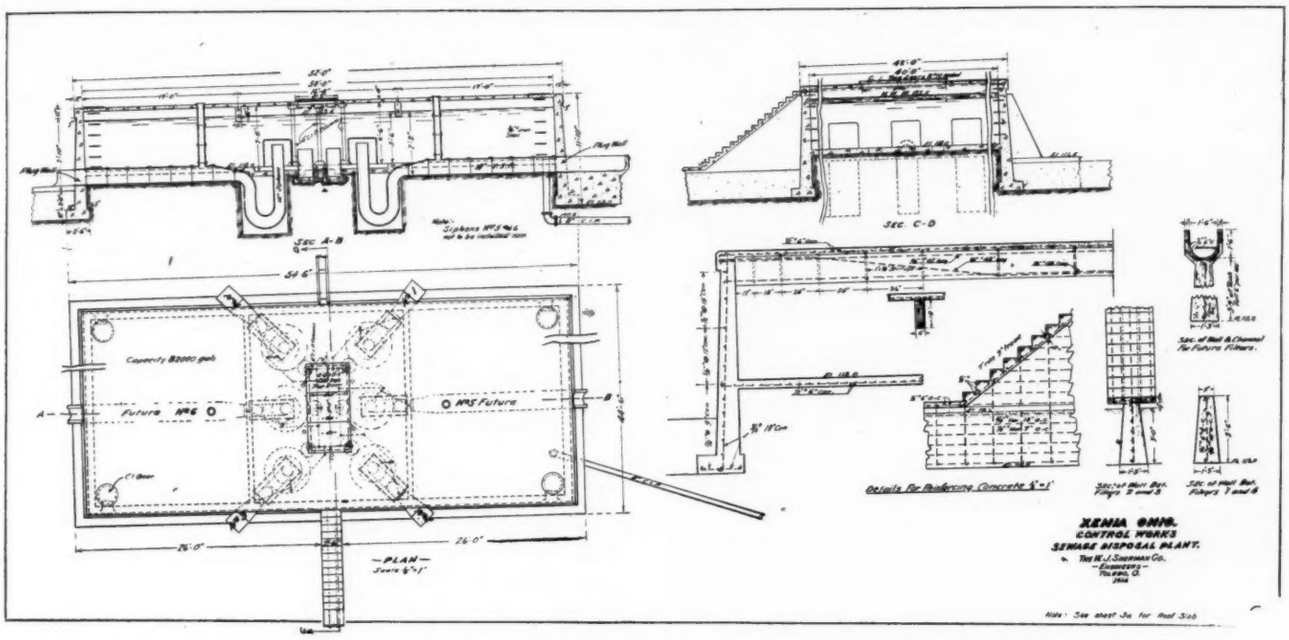


FIG. 4—DETAIL OF CONTROL WORKS FOR SEWAGE SAND FILTER BEDS AT XENIA, OHIO.

6 in. of gravel, ⅛ in. to 1 in.

6 in. of stone, ¾ in. to 2 in.

The carrier system was first designed for galvanized iron carriers, but on account of war prices (13c per pound), was changed to vitrified pipe resting on reinforced concrete slabs.

Contract Prices

The contract prices were as follows, viz.:

Item.	Cost.
Excavation in filter beds, per cu. yd.	$ 0.40
Excavation in tanks, per cu. yd.	1.00
Filter sand and gravel, per cu. yd.	.80
Concrete in tanks, per cu. yd.	15.00
Concrete in control chamber, per cu. yd.	8.00
Reinforcing steel, per ton.	110.00
14-in. siphons in place, each.	550.00
20-in. sewer pipe in place, per ft.	.85

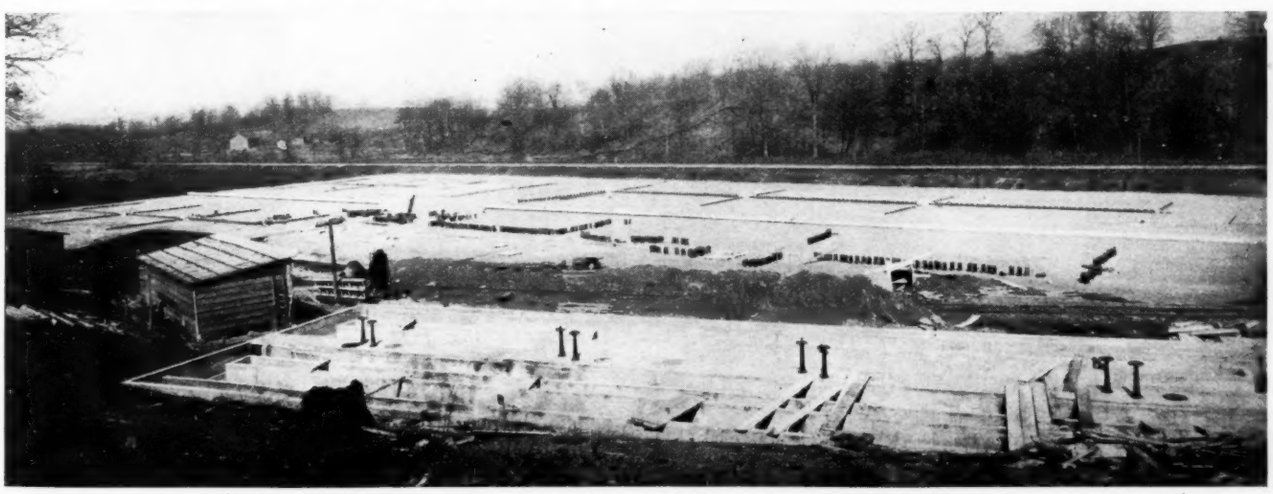


FIG. 5—VIEW OF NEW SEWAGE TREATMENT PLANT AT XENIA, OHIO.

Trenching per ft., 30c for 6-ft., up to $9.70 for 32-ft.	
Manholes	40.00

Construction Costs

The construction costs have been as follows:

Trunk extension	$ 8,346.00
Settling tanks	19,102.25
Sludge bed	742.00
Control house	4,883.00
Sand filters (4 acres)	24,627.12
Lands and right of way	2,970.00
Printing and advertising	262.12
Contingencies and engineering	5,027.61
Total	$65,960.10

Personnel

The contractor for the plant was R. T. Bailey, of Dayton, Ohio; the resident engineer was Mr. Frank Guthrie, Cincinnati, Ohio; the designing engineers and superintending engineers were the W. J. Sherman Company, Toledo, Ohio.

BRIDGES AND BUILDINGS

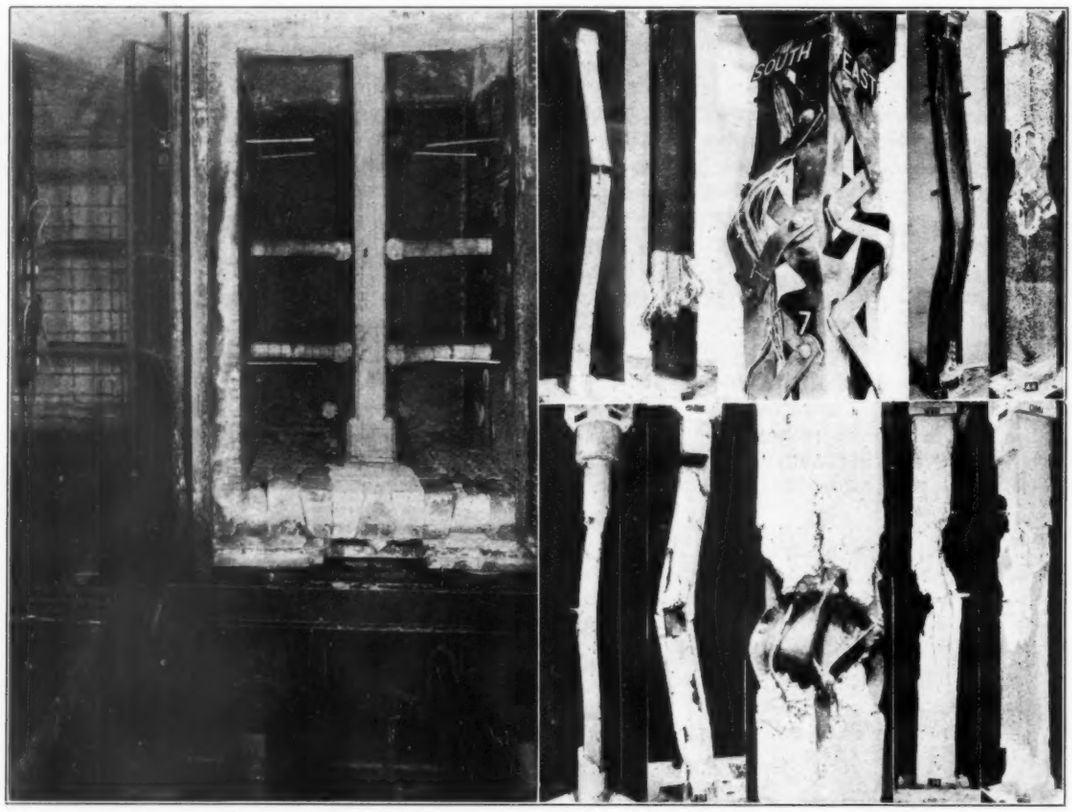
Apparatus and Procedure Used in Making Fire Tests of Building Columns

By W. H. Merrill, President Underwriters' Laboratories, Chicago

Fire tests of building columns, being jointly conducted by the Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters and the Federal Bureau of Standards, at Underwriters' Laboratories, are progressing according to schedule, two columns being tested each week.

Apparatus Used

The apparatus used in the tests consists briefly of a gas furnace capable of being controlled according to a specified standard temperature curve, reaching a maximum of 2300 degrees Fahr. (1260 degrees Cent.) at the end of an eight-hour test. The load on the columns while being subjected to fire test is supplied by means of a hydraulic ram, an average load of 100,000 lbs. being maintained during the test, this being calculated for the various sections according to accepted formulas for working load.



TESTING FURNACE AND ACCESSORIES WITH COLUMN READY FOR FIRE TEST. EFFECT OF LOAD AND FIRE ON SOME SAMPLE COLUMNS TESTED.

The work of testing began last summer and will require a year for the completion of the full series of 100 tests. This was preceded by several years' work in designing and erecting the testing apparatus and in preparing and covering the test specimens by the different methods and with the various materials required for a full investigation.

Measuring Temperature

The temperature of the column furnace is measured by means of platinum and base metal thermo-couples, supported in porcelain tubes at two elevations; and that of the columns by means of base metal thermo-couples attached to the metal of the column at four elevations and at different points in the

section. The temperature indications are read with a potentiometer indicator and connections are also made to an automatic potentiometer recorder, so that graphic records can be obtained, if desired, of the indications of any set of couples.

Measuring Elongation and Shortening

The vertical compression and expansion of the columns, due to the load and heat, are measured over a gauge length of 37 in. in the upper half of the column by means of wires attached to the column at each end of the gauge length, the other ends being weighted and passed over an idler at a point outside of the furnace and as far from the column as room conditions will permit. The wires are protected inside and outside of the furnace by suitable insulating and protecting tubes. Readings of vertical movement are taken at intermediate points on the wires by means of microscopes mounted in micrometer slides, the true movement at the column being calculated from the distance relations of the microscopes and the fixed end of the wire, with reference to the point of attachment to the column. The lateral deflection of the column is measured by means of readings on scales placed perpendicular to and parallel with the wires.

A partial view of the testing furnace and accessories with a column ready for test is shown herewith.

Test Specimens

All of the tests are of full-sized columns of 12 ft. 8 in. effective length and of various steel sections, which are protected by concrete, tile and other forms of fire-protective coverings. One column of each type is tested unprotected; also several concrete columns reinforced according to methods used in current practice have been introduced.

Tests to Destruction

The tests are continued to a break-down of the sample, and hence no inferences as to the comparative merits of the various column designs and column coverings should be drawn from the illustrations, which show simply the effect of load and fire on a number of samples which have been subjected to test. The time required to obtain failure varies with the type of material and thickness of covering, the periods for the columns so far tested ranging from 17 minutes for the unprotected column to over eight hours for the heavier types of protection.

These the Pioneer Tests

This is the first work of this character ever undertaken employing modern forms of columns and methods of protection, and it is expected that it will develop data of great interest to city governments, underwriters, manufacturers, architects and engineers.

Specifications for columns and column coverings have necessarily been made ever since the advent of modern fire resistive construction, but there has been little or no experimental data as a basis for the various requirements promulgated, which in point of amount of protection required differ by more than 100 per cent. as between various city building codes.

Tests Will Lead to Rational Specifications

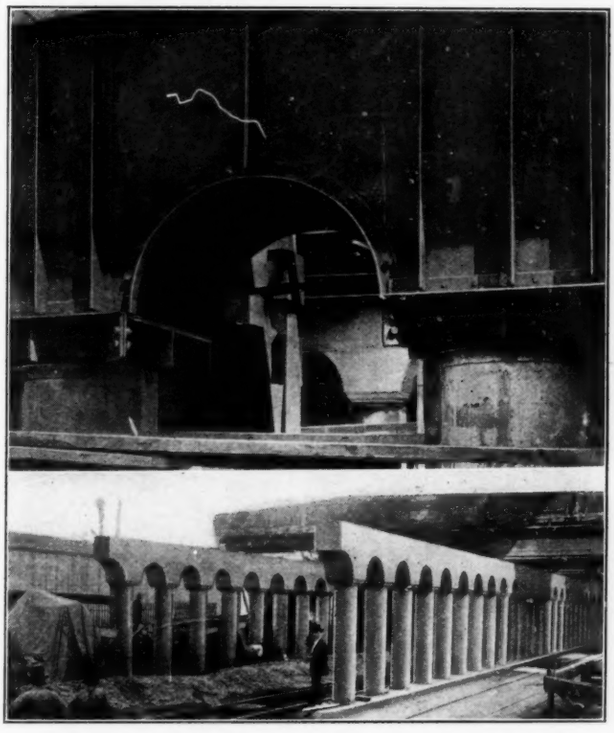
It is also thought that the tests will give much information on the general fire-resistive qualities of the covering materials employed. Differences in point of effectiveness of over 100 per cent. have already been found as between concretes made from different aggregates, some showing up unexpectedly well and others indicating decided unsuitability for use where the fire-resistive feature is a point of importance.

Successful Use of Built-Up Steel Concreting Forms on Track Elevation Construction in Chicago

The reconstruction of the Illinois Central Railroad bridges over the street crossings within the city limits in Chicago, incident to the track elevation construction, was begun in the spring of 1915, and has been carried through continuously without interruption to traffic to the present time. The work will probably be finished in the fall of 1918.

The railroad has purchased all forms for use on this work, but the placing of the concrete and erection of forms, etc., has been done by contractors.

In 1915 the John J. O'Heron Company of Chicago built six bridges, namely, over 113th, 111th, 109th, 107th, 105th and 103d streets. Each of these bridges contains three rows of columns and cross girders. Forms were furnished for two complete rows, 114 ft. wide. The columns are on 6-ft. centers resting on



VIEW OF BLAWFORMS USED ON TRACK ELEVATION CONSTRUCTION IN CHICAGO AND OF CONCRETE COLUMS AND CROSS-GIRDERS CAST IN THEM.

heavy reinforced beams, which in turn rest on caissons 4 ft. in diameter, going down about 32 ft. to hardpan and bolled out in some cases to a diameter of about 8 ft.

In 1916 Bates & Rogers, contractors, built two bridges, one at 100th street and one at 82d street. In 1917 the Gould Construction Company built four bridges, namely, 67th, 65th, 64th and 63d streets.

As the work progressed nearer Chicago the width of the bridges was increased and at 63d street the width is 160 ft. In some of the crossings four rows of columns and cross girders were built and on some only three, but the contractor had at all times enough forms to set up any two rows.

All of the forms ordered since 1915 are now in use and are in good shape. The forms have been coated with light form oil after each use and the work obtained now is as near perfect as can be found. The forms have been used on an average of about 20 times each, and by the time the work is finished, next fall, they will have been used at least 30 times.

This work is under the direction of the Bridge Department of the Illinois Central Railroad, Mr. C. C. Westfall, bridge engineer. Mr. M. D. Thompson, assistant bridge engineer, is in direct charge of the work. The contractor in each case used a mixer on a car served with concrete materials in gondolas in the same train. Concrete was delivered from the mixer into wheelbarrows and from there into the forms.

Precast slabs made in Burnside, Ill., are being used for the decks of the bridges.

Speed in Fireproof Roof Construction

When the American Spiral Pipe Works, Chicago, commissioned Davidson & Weiss, the architects, to prepare plans and specifications for their new building, they advised Mr. Davidson that one of the most important factors was speed of erection. They had to have the building with as little delay as possible. This, of course, with safe and sane construction, and at a minimum cost. Mr. Davidson accepted the commission with this understanding, and within 50 working days after the plans were started the building was completed and turned over to the owners.

Some of the other requisites of this building were maximum light, maximum ventilation and a non-condensing fireproof roof deck.

Pyrobar gypsum long-span roof tile was selected as the roof deck material for this building, because it could comply with all these requirements and at the same time not cost any more than an ordinary non-combustible roof deck. Its light weight (15 lbs. per square foot) effected a considerable saving in the steel work, its low co-efficient of conductivity insured against condensation, its white undersurface materially added in the diffusion of light, and the ease and speed with which it could be erected guaranteed the roof deck being erected on time regardless of the weather conditions.

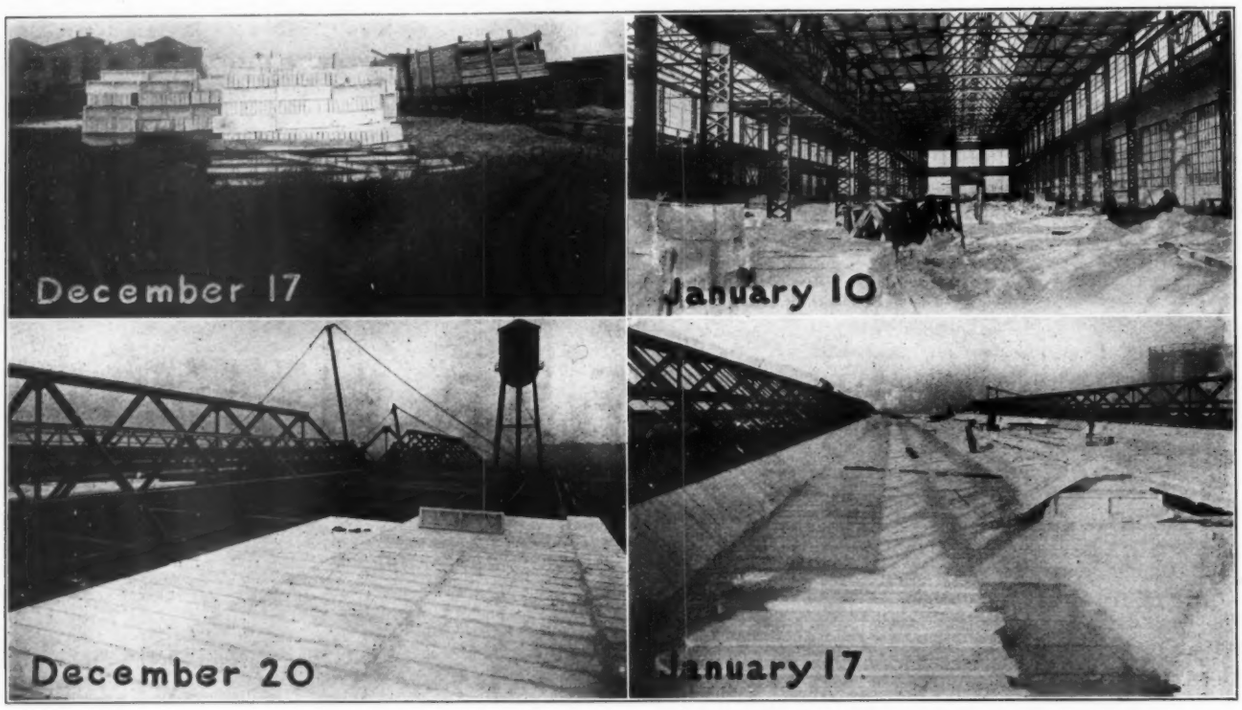
This building was erected in two of the coldest winter months, December and January, and in the early part of January one of the worst blizzards occurred that Chicago has ever experienced. This blizzard and cold weather did not delay the job, work continuing right through and being finished on time.

The accompanying views show (1) the tile on the job three days after receiving the contract; (2) the tile erected in place, and (3) the underside of the roof deck, 38,000 sq. ft. laid. Note the amount of snow inside the building; this gives some idea of the weather conditions that prevailed while the job was being erected. Finally (4) is shown the roof deck erected complete, ready for the roof covering.

Due to the decreased cost and the increased lighting and ventilating efficiency this type of building was adopted instead of the saw-tooth type. The purlin spacing being 5 ft., the standard stock lengths of tile were shipped, thus avoiding waiting for special lengths to be manufactured.

Where tile longer than 6 ft. and up to 10 ft. are desired they are molded at the building site. The "Structolite" (a specially prepared gypsum) from which the tile are made is shipped to the job in bags, where it is mixed with water to the proper consistency and poured into the molds. It sets in 15 minutes and can be removed from the molds in 30 minutes.

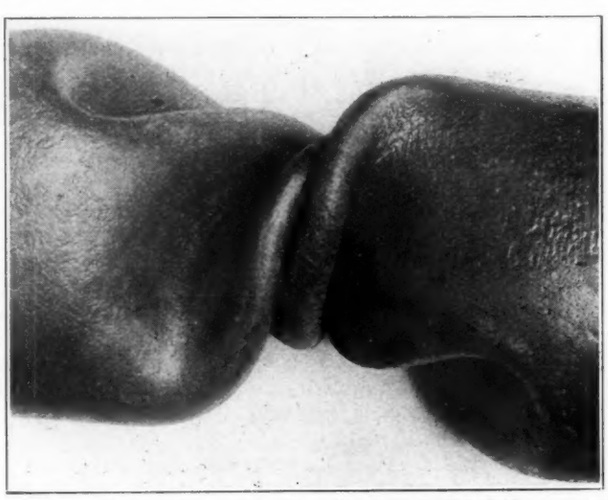
The United States Government, recognizing the conservation of steel effected by the light weight and the saving in time due to the speed of erection, has used over 2,000,000 sq. ft. of Pyrobar gypsum roof tile on recent installations.



VIEWS SHOW RAPID PROGRESS IN FIREPROOF ROOF CONSTRUCTION ON A CHICAGO BUILDING.

Iron Pipe "Twists Like Rubber"

After having been subjected to a torsional stress of 713,000 lbs., the piece of pipe shown in the accompanying illustration was found to be intact as to wall surface. No leaks were developed in the process, altho the pipe was twisted thru a complete turn.



The pipe on which this unusual strain was put was an 8-in. "National" line pipe weighing approximately 29 lbs. per foot. The walls are 1/3 in. in thickness.

FROM WORKERS IN FIELD AND OFFICE

Practice in Thawing Water Service Pipes, Mains and Hydrants in North Attleboro, Mass.

Editor MUNICIPAL ENGINEERING:

Sir—The North Attleboro Water Department, North Attleboro, Mass., like a majority of the water works departments in New England, has just experienced the most severe winter it has known. The frost has penetrated to a depth of from 3 ft. to 6½ ft., depending on the nature of the soil.

Depth of Freezing

During the past several weeks, starting December 24, 1917, several water service pipes of ½, ¾, 1 and 2 in. diameter were frozen, and later, in January, 1918, 6-in. cast iron water mains. The water department had a similar experience in 1912, when the frost penetrated to a greater depth than had been known up to that time; but in 1912 no 6-in. pipe was found frozen.

In 1912, the writer, manager of the Electric Light and Water Department, made up an electric thawing apparatus, consisting of a 20-kilowatt transformer, 2,300-volt primary and 110 and 220-volt secondary. This was an ordinary lighting transformer and worked very satisfactorily for all pipe up to 2-in.

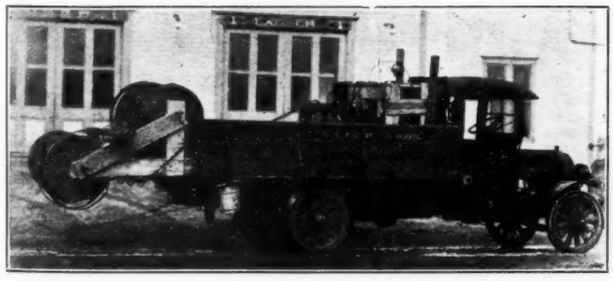
During the past winter the frost reached not only to the service pipes supplying residences, stores and factories, but to 6-in. cast iron water mains and 6-in. branch pipes leading to fire hydrants.

In the majority of cases where water could not be gotten through the hydrant, it was found that the branch pipe leading from the main to the hydrant was frozen. But the main itself was clear on account of the circulation of water due to water being used by consumers, leakage, etc., keeping the main from freezing.

Thawing Equipment

The Water Department provided equipment the past winter to thaw out any size pipe up to 8 in., including 7-in. barrel hydrants, and it has worked out satisfactorily.

The accompanying illustration shows a 3-ton Velie truck with the following equipment: Two 50-kilowatt General Electric Company lighting transformers, 2,200-volt primary and 110 and 220-volt secondary; an ammeter, General Electric Company make, 0 to 100 ampere reading, located at the top of transformer and connected on the 2,200-volt side of the circuit. On the front of the transformer, where the secondary or low voltage cables are located, there are mounted four single-pole 600-ampere fuse blocks, used for changing voltage from 110 to 220, or vice versa, and the 110 and 220-volt wires are connected to these blocks. Instead of fuses, heavy copper bus bar blades are used. The changing of the bars to get the desired voltage is made while the current is shut off.



VELIE 3-TON TRUCK EQUIPPED WITH ELECTRICAL EQUIPMENT FOR THAWING FROZEN WATER PIPE.

A large double-pole single-throw knife switch is mounted at the top of the left transformer, as shown in the illustration, which disconnects all low-voltage electricity to cable running into the house and fire hydrant.

Then 2,200-volt electricity is carried to the transformers on the truck and connected to General Electric Company primary cut-outs, which are located on the opposite side of the truck,

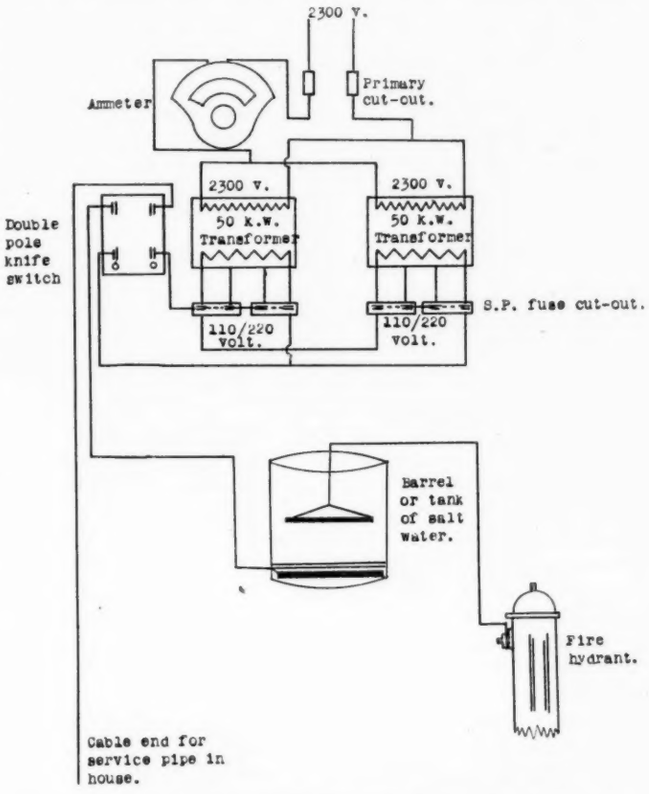


DIAGRAM OF ELECTRIC THAWING EQUIPMENT USED BY NORTH ATTLEBORO (MASS.) WATER DEPARTMENT.

as shown in the view. No fuses are employed in any part of the equipment. Current to the extent of 100 amperes on the 2,200-volt side has been drawn through the transformers.

One low-voltage cable is connected (see diagram) to a cast-iron flange, which is located in the bottom of an oil barrel, the barrel being half filled with water containing 4 lbs. of common table salt. The top cable coming out of the barrel is used to regulate the flow of current. On this cable is bolted another cast-iron flange 16 in. in diameter and 1 in. thick, this being lowered or raised by the hand of the man operating it, who at the same time observes the ammeter on the transformer, which indicates the amount of electricity in amperes flowing. If he is thawing with 110-volt electricity he simply multiplies the ammeter reading by 20, which will give him approximately the current on the secondary side of the circuit, which is the ratio of transformer, 2,200 to 110 volts, the current being practically in the same ratio, and if the 220-volt is used he multiplies by 10; by keeping the ratio of transfor-

mation in mind he can readily at a glance determine the flow of current he is using.

The 110-volt electricity is used on short services and the 220-volt on long services.

The two reels on top of the truck, as shown in the illustration, are 1,500 ft. of twin flexible insulated stranded cable; when customers with frozen services are beyond reach of the 2,200-volt primary circuits of the town's lighting system, then the twin conductor cable is laid on the ground to the truck.

Using the Equipment

The three bottom reels contain 1,200 ft. of No. 00 stranded weather-proof cable. This end of the cable is carried into the house and wound around the pipe, to make a good connection with the pipe to be thawed. The other end of the cable is connected to a short cable coming from the double pole switch. Two bolt guy clamps were used in connecting the cables together.

The end of the cable coming out of the barrel is fastened under the cap of a fire hydrant, thereby completing the circuit through the water main and the house service pipe (see diagram).

After the electricity is brought to the transformer in the truck, the main switch is thrown in, then the top cable with the cast-iron flange is lowered into the barrel containing the water; the farther this is lowered into the barrel, thereby bringing the upper plate near the lower plate, the greater will be the flow of current.

Great care must be taken on account of the kind of pipe to be thawed; i. e., an old plain iron or galvanized pipe cannot withstand as much current as a new pipe of a similar size, on account of the deteriorated condition of the threaded joints, unions and couplings, etc., which might burn the pipe off, due to unusual high resistance.

Time and Current Required

Lead service pipes ¾ in. diameter require approximately 300 to 500 amperes of current, while the plain iron or galvanized or cement-lined iron requires from 150 to 400 amperes, depending upon the size and conditions. The time required to thaw such pipe is about 5 to 15 minutes, and in some cases 20 minutes.

Six-inch cast-iron water mains require 500 to 800 amperes, and in some instances 900 amperes; 6 and 7-in. barrel fire hydrants, which is the ordinary 2-way or 3-way, 2½-in. nozzle type, require from 500 to 900 amperes.

In one instance it took only 15 minutes to thaw a 6-in. cast-iron water main, current flowing through the pipe 800 amperes at 110 volts. In another instance it required 1 hour and 10 minutes, with a current of 500 amperes, and at times raised to 600 amperes, at 220 volts; and another 6-in. main, 3 hours and 45 minutes, with a current of 500 to 600 amperes at 220 volts.

The difference in the time required was undoubtdely due to the fact that some of the mains were frozen a greater distance than others.

We also thawed 300 ft. of 3-in. wrought-iron steam pipe line running between two factories; the time was 15 minutes at 450 amperes, at 110 volts.

In another case we thawed a 5-in. cast-iron sewer pipe running between two buildings; the time required was 45 minutes, with a current of 540 amperes at 110 volts. The cable was connected or twisted around the iron pipe in one of the buildings and the other end of the cable on the sewer soil pipe in the other building.

Organization of Crew

Our crew consists of nine men, as follows: Two on truck operating main switch and cable in the barrel; one lineman, who connects all wires to the 2,200-volt lines; one hydrant man, who sees that the cable is properly secured under the cap on the nozzle and sees that a good contact is made; two men in the cellar to connect cable on the pipe to be thawed, and also inspect all piping as to joints or whether the water pipes are laying on gas pipes or come in contact with any other underground structure, etc.; three men to pull cable and guard it when laid in the streets, also guarding the high-tension 2,200-volt cable. With this outfit we have thawed as many as 32 services in one day, and in each instance thawed out on an average of three consumers to a "hitch."

The frozen service pipes were not confined in any one particular locality in the town, but pipe was found frozen in remote sections of the town, as well as in the congested district. Most of the frozen services were found in coarse gravel and ledge and rocky soil, where the frost penetrated to a depth of 6½ ft. In hardpan and clay soil the frost penetrated only to a depth of 3 to 4 ft. The average cost, including all charges and depreciation on cable, which runs high in such cases, was approximately $8 per service.

The electric thawing apparatus has been used by the Water Department since 1912.

Very truly yours,

WM. PLATTNER, *Manager*,
Electric Light and Water Dept.

North Attleboro, Mass.

Military Highways Vital Element of National Defense

Editor MUNICIPAL ENGINEERING:

Sir—Military highways are an immediate as well as a future necessity of the military establishment of this nation. Motor transport is a vital part of our scheme of National Defense, but without suitable highways upon which to operate it, it is as helpless as railroad rolling stock without rails.

A majority of our so-called modern highways have already become obsolete and their maintenance in condition to permit of the use of high speed motor trucks is an important consideration. Many thousands of miles of our roads are still earth, or light waterbound macadam and unless such of these as are main arteries of travel and important feeders are improved, will soon become as impassable under heavy traffic as were many of our trunk line railroads during the heavy snow storms of last December and January.

The present crisis is a national one. The present extraordinary traffic on our highways is the nation's business and is increasing in volume as well as weight every day. Only those in charge of the military defenses and necessities of the country are in a position to select highway routes of the greatest strategical value. Such routes must necessarily be speedily placed and maintained in serviceable condition regardless of state boundaries or finances. The federal government is now very properly directing rail and water transportation as a military necessity.

The control and maintenance of the right of way of motor transportation is also the nation's business as a military necessity.

Very truly yours,

CHARLES N. FORREST.

Maurer, New Jersey.

Why Hard-Surfaced Roads Should Be Built This Year

By J. Denny O'Neil, State Highway Commissioner, Harrisburgh, Pa.

I am not in favor of cessation of road building on account of the war. Roads are an economic necessity and, even in war times, I am sure that the state and the counties are justified in the construction of permanent roads, which will help to relieve the congestion of the railroads and, at the same time, work into a definite road system that will connect the important centers of population and also enable the farmers to get their products to market.

If we want to keep the people—particularly the boys and the girls—on the farms, so that they can produce foodstuffs necessary to supply our cities, we must give them good roads.

If we fail to do this, they will join the ever-increasing throngs constantly moving to the centers of population.

It is true that roads cost more now, but everything else costs more in proportion. Part of the increased cost of roads is caused by the fact that the cheap types that were constructed in former years will not stand up under the motor truck traffic of today. Truck traffic is increasing by leaps and bounds and it requires a much better type of road to stand this kind of traffic.

Belgian Engineers Want to Hear from American Manufacturers of Contractors' Heavy Equipment

Editor MUNICIPAL ENGINEERING:

Sir—We are two Belgian engineers and are indebted for your address to our firm, Messrs. Landre & Glinderman, of Amsterdam, Holland, to whom, as to us, you have rendered many favors. We have communicated with you many times before.

The war having given us much leisure for three years, we have devoted our spare time to a thorough study of everything relating to pile driving, both pile-driving machinery and pile-driving theories, and have written a technical work in French, which will be published in Paris in a few weeks. We have described in this work a very great deal of machinery of Vulcan,

As our work is now on the verge of completion, we intend to proceed with our studies and to extend them to contractors' heavy machinery and equipment, such as: dredges, locomotive cranes, dump cars, cableways, pumps, concrete mixers, excavating machinery of all kinds, elevating graders and steam shovels.

Consequently we respectfully ask you to assist us, and facilitate our task, by requesting all the firms who advertise in your publication to send us such complete sets of their literature as they think would be of interest to us.

At the same time we would esteem it a great favor if they would allow us to reproduce in our book the figures we should desire to use for illustrations.

Very truly yours,

EDOUARD NOE,
Amsterdam, Holland,
Spuistraat 6-8.

January 18, 1918.

We Must Improve Roads to Win the War

Editor MUNICIPAL ENGINEERING:

Sir—Food production is urged as an absolute necessity for winning the war. This is not called in question by anyone and all loyal people will support the injunction to the utmost, but there is a well defined gap that lies between the actual production of food and where it is wanted for use. This gap is camouflaged in so many ways, embracing withal, the practical, the theoretical, the sentimental, possibly the ignorant, and I greatly fear, involving ulterior motives which, if not unpatriotic, at least bear evidence of selfishness.

What is the secret which influences a man to say regarding a road building project that it should be strictly limited to that which will contribute to the successful prosecution of the war or which is necessary for public health and welfare, and then, with seeming fear that such langauge scarcely bears sufficient force that there is added that local and personal interests must be subordinated to public welfare?

Has anybody ever suggested a warning against plowing corn more than two or three times, or limiting in the same way the cultivation of a potato crop, and if so, what on earth could be the motive for such a suggestion?

Can there be any difference in doing what is necessary for an economic crop production and that which in all its details makes for the largest crop at the least expense, or doing that which is necessary for the economic movement of that crop to where it is wanted? What sort of wisdom is it that undertakes to draw the line of difference?

Why then should there be an insidious attack against methods of crop movements the moment the bushel of wheat is threshed? Is there any difference at all between a sane and economic production of the largest number of bushels per acre and a safe and economic delivery of that which is produced and if there is a difference, wherein the difference?

Is it not proper to spend money to save money in the delivery of food as well as to spend money for the economic yield of production?

Is it possible that this question of highway improvement involves a theory of wastefulness, extravagance or lack of economy? Is there some kind of visionary sentiment that connects up road improvement with a lack of patriotism? Is it possible that any character of discouragement for road improvement emanates from a lack of loyalty to the country, or is it a fear existing somewhere that improved highways will demonstrate an economy in the movement of so large a tonnage that it will go further than an immediate contribution to public welfare or an abundant food delivery for war success by taking away from other means of transportation a share of haulage for which, by reason of custom, the water and railway have established an exclusive claim?

In other words, does anybody or any interest fear that the utility and economy of highway transportation will be demonstrated?

Will there be no new engines purchased? Will old engines be repaired? Are worn-out cars to be replaced? Are tracks to be re-ballasted? Are worn and broken rails to be continued in use? If so, and if not, why? Or, shall all the energy possible be employed to maintain transportation in a practical, usable condition?

Are the highways of the country to play any part in supplying transportation needs of the country toward maintaining its industrial and financial strength in competent condition to meet the financial needs of the country?

Is it any concern that two fundamentals need to be recognized at this time? The one is that the financial strength of the country results from its greatest activity and that stagnation does not require any circulating medium at all.

"Nothing to buy" and "nothing to buy with" stalk in close companionship. Is there any significance in the price of 50 cts. per peck for potatoes in the grocery store and 3,000,000 bushels rotting in the field; is there no hurry for auto trucks at the war front in France that they should stop to wallow in the mud hub deep on roads of Ohio and Pennsylvania?

If a system of repression is to be inaugurated, rather than one of stimulation, for the country's sake let it be directed towards the thousand and one things that respond only to taste, fancy, extravagance or luxury; but give impetus to the one great commercial need in this time of needed wisdom, the needed increase in transportation facility which is vital all the way along the line from the toiler in the shop to the soldier in the trench.

Only last week we were informed by a responsible and patriotic citizen of Illinois, that he could not get into market his 30,000 bushels of corn, though within 30 miles of idle meal and hominy mills. This story was emphasized by a market experience of paying 8 cts. a pound for corn meal.

"What might have been" possible both for the comfort of the people and their undisturbed business activity throughout Ohio, Indiana and Illinois, *if all the people* had been situated as detailed by a trustworthy man but a few days ago—saying "Though I could not buy in my own neighborhood a pound of coal and my family would have suffered greatly, I fortunately lived on a good road with a coal mine 40 miles away. An auto truck furnished what was lacking and I supplied myself with ample fuel."

No car, truck or wagon has been turned away empty from

the coal mines. But coal at mines, or corn in the field is worthless to the freezing and starving. The financial loss due to a lack of fuel during the past winter, would build all the roads and do all the repairing under contemplation for the year 1918.

It is not extravagant to say that due to the bad roads the 1917 corn crop will deteriorate in quality—that measured in dollars and cents will exceed the amount of contemplated road improvement for 1918. The great amount of damp and soft corn that would be saved, or saved in part by being put into the dryers will be destroyed by decay, if held in the cribs or field until the roads dry up. Shall not encouragement be given to curtail these recurring financial losses?

Remove the spy glasses and ordeal of inspection and limitations to which it is proposed to subject all road projects, under the injunction to limit the road improvement to such as are necessary for public welfare.

The sources that inspired the imaginative fear that some road might be built in these times that would not contribute to both military and public welfare are hallucinatory breeding spots for which we should have but little use in times demanding the most serious action.

With the losses to labor and capital, the discomfort of thousands of families, the disruption of business, the difficulty in moving military supplies, and the inadequate distribution of food, experienced and confronting us, what official, what community, what state is proposing to build a road that is not urgently needed for military or public welfare or both?

Cleveland, Ohio. WILL P. BLAIR, Secretary,
National Paving Brick Mfgrs'. Assn.

PLANT UNITS AND LAY OUTS

The Versatility of the Portable Air Compressor

A Philadelphia gas company, that has been using portable compressors with a great deal of success, is responsible for the statement that there is no limit to the possibilities and accomplishments of these outfits. The accompanying photographs are confirmatory evidence of the truth of this statement.

In opening up a new trench for the laying of gas pipe, rock was encountered and immediately they put a Schramm rock drilling outfit on the job, the pneumatic hammer used being a one-man proposition. The steels were made of ⅞ in. hexagonal high carbon material. A smooth, straight hole passes down through the center, through which air is forced to blow out the chips. These drill steels can be swedged out on the end to drill a hole for receiving any standard stick of dynamite. No matter how narrow the trench may be, these outfits can handle the work with ease. With this outfit an average of 20 4-ft. holes (80 ft.) a day were drilled by one operator at the cost of the man's wages and 5 gals. of gasoline.

The trench being open, the pipe was laid and again the compressor was put to good use caulking pipe joints. This meant that the streets did not have to be kept open long, because the work was done in less than one-third the time it would have taken by hand. The joints were better made and only 3 per cent as many leaks appeared as when caulked by hand. The excavation did not need to be so large, because the caulker did not need to move about much. The operator is relieved of the strain of stretching or twisting over the joint experienced when trying to get a good chance to deliver the proper blow by hand. The pneumatic caulker can be held in either hand and the blow can be tempered down to any weight.

Another step in the operation was the testing of the pipe. The old way was to put several laborers on a hand pump and in this way the pressure was gradually raised with much effort. Oftentimes when the pressure was high enough for testing the joints, the men at the pump would become tired and the pressure would drop. By putting a portable compressor on the job and setting the unloader or automatic pressure regulator to the desired pressure, the machine will do the rest, enabling the men to continue testing all the time.

Now when the final stage had been reached and the dirt returned in the hole they found a still further use for the portable compressor. That was tamping down the earth. The work was done by one operator at the rate of 8 ft. in five minutes, in a ditch 3 ft. wide. The ground was so solidly packed that a pick was required to loosen it.

VIEWS ILLUSTRATING USES OF THE PORTABLE AIR COMPRESSOR.
Left to Right: Operating Pneumatic Rock Drill in Trenching—Caulking Bell Joint with Cast Lead or Lead Wool—Testing the Tightness of New-made Joints—Tamping Trench Backfill.

A Calculator for Proportioning Ventilating Duct Systems

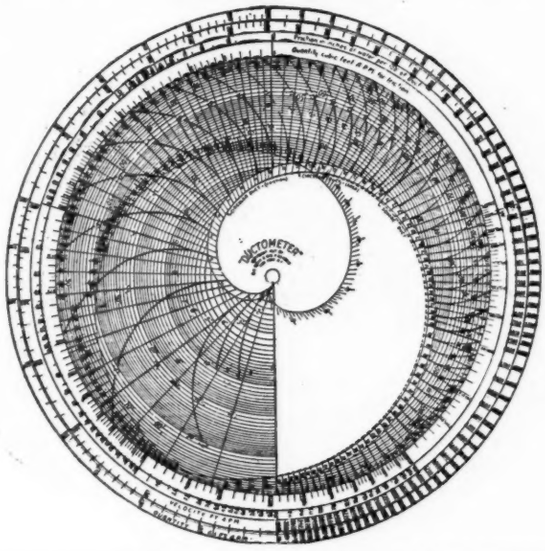
To proportion an air duct system by the use of arithmetical solutions of formulae is a long and tedious task, and it is the purpose of the Ductometer, here illustrated, to simplfy this work by using the common factors, such as: Quantity in cu. ft. A. P. M. velocity in feet per minute, sizes in inches and

frictions or loss of head in inches of water—to reduce the time of labor and retain the desired degree of accuracy.

The Ductometer consists of two discs 6 ins. in diameter, one superimposed upon the other and pivoted in the center.

The lower disc, which is opaque, has on it an outer scale, representing the quantity in cu. ft. A. P. M. to be delivered, which is used to find the dimensions of the ducts for area. A scale marked "friction in inches of water per 100 ft. of duct," which represents the loss of head due to friction. A scale marked "quantity cu. ft. A. P. M.—for friction," which represents the relation between the quantity A. P. M. and the frictional size of the duct, and is used to find the pressure as compared with a square duct. The curves represent the length of the side of a square duct; the diameter of a circular duct of equivalent frictional resistance as compared with a square duct, and the diameter of a circular duct of equivalent area, as compared with a square duct, respectively.

The upper disc is transparent, and has on it an outer scale, which represents the velocity in feet per minute; the



THE DUCTOMETER FOR CALCULATING PROPORTIONS OF VENTILATING DUCTS.

indicators, which represent the constants for frictional losses in ducts of smooth metal, rough metal, smooth plaster or concrete, rough plaster or concrete and brick, respectively, for air at 70° F.; an inner scale, which represents both the larger size of a rectangular duct, and the length of the side of a square duct, and an indicator curve. The calculations are based upon the formula in common use for this purpose.

The Chemical Method of Killing Weeds

To the average city the problem of maintaining weed-free streets during the spring and summer months is a vexing one. Weeds will grow where least wanted despite all that can be done to prevent it, and unless drastic measures are used, it is difficult to attain the ascendency of them.

Not only are weeds a sign of "poor housekeeping," giving the street an unkempt, uncared-for appearance, but they will actually ruin a paved street's surface if allowed to thrive in the interstices of the bricks or stones. The constant root growth will gradually lift even a heavy block out of position. If in the gutters, they will prevent proper drainage and collect filth and refuse, becoming a potent source of disease and contagion. A rank growth of weeds in a vacant lot covers many evils in the shape of debris, cans, rubbish, discarded raiment, deceased family pets, etc. Each of these weed-grown lots is a blot on the municipality and a constant danger to its inhabitants, which was proven during the recent epidemic of infantile paralysis.

With the arrival of weeds in May, comes the question: "How best can we get rid of them?" Labor is expensive and difficult to procure with present conditions. At the best, hand-weeding or cutting merely serves to keep down the growth for a week and the cropping renders the plant more sturdy and vigorous. Where weeds are pulled in dirt roads, a certain

METHOD OF APPLYING CHEMICAL WEED KILLING SOLUTION.

amount of the road material clings to the roots and is cast away; rains following cause washouts where the surface has been disturbed. With paved roads, the roots cannot be reached even with a cutting machine.

The chemical method has, therefore, proven attractive to many cities both from the standpoint of efficiency and its decided economy. The weed killer is mixed with water in a dilution varying from 1:20 to 1:40 and applied by means of a watering can or street sprinkling cart, with which extensive territory can be treated. It will sink into the interstices on paved streets and kill the roots. One application, it is claimed, at a cost of about half that of hand-weeding, will easily suffice to prevent weed growth for the season and eradicate most of the softer plants. The work should be accomplished preferably after the period of full growth has been arrived at, as the plant then lacks resistance and is more susceptible to chemical action.

There are a number of weed killers on the market. One of the most widely used, known as Atlas "A," is manufactured by the Chipman Chemical Engineering Company, Inc.

A Low Loading Mixer with Four-Motion Mix

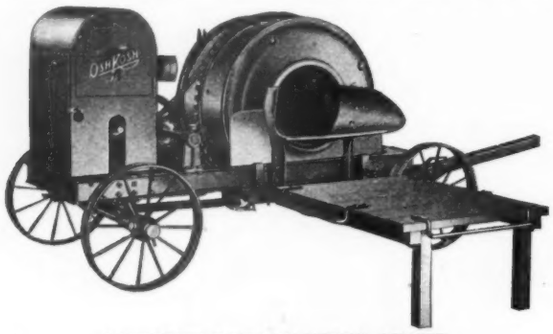
To the buyer of a concrete mixer, the four-motion mix has a value which should not be overlooked. This feature of the Ransome-Leach low-loading mixer, here illustrated, insures a thorough mix at a great saving in time, and as every user of concrete mixing machinery knows, the time element is of prime importance in the purchase of equipment and acceptance of contracts.

The four-motion mix operates as follows: When the dry material is dumped into the drum it is thrown against the paddles. As the drum revolves the paddles turn it over into the buckets, which carry it up an drop it on the inner end of the discharge chute. This throws the mix back into the paddles again and the operation is repeated. In this way the batch is split up and turned over four different ways all at once.

The steel blades or paddles, which are very heavy, are raised from the drum to allow water to run under, wetting the

whole batch quickly and keeping the drum washed clean. This four-motion method is speedy and thorough, producing a very smooth mix. The mixer turns out a batch a minute. Many users say it works even faster than this and produces a perfect mix.

Another way this mixer saves time is through its ease in loading and quick discharging. It has a low loading platform from which all material is dumped into the hopper from a



OSHKOSH LOW-LOADING MIXER.

wheelbarrow. The discharge chute is the proper height for loading into a wheelbarrow conveniently. Minimum time is required both in loading and discharging.

When desired, this mixer is equipped with a power-driven hoist for elevating the concrete. Power is furnished by the Novo engine, which is well known for its simplicity and economy.

Testing 25 American-La France Pumping Cars in New York City

Twenty-five American-La France pumping cars were recently delivered to New York City. Each car was subjected to a severe 12-hour underwriters' test. All of the 25 cars passed thorugh this test succesfully. These cars were guaranteed to deliver 700 gals. per minute at 125 lbs. pump pressure. The average capacity for all cars on all tests was 716.3 gals. per minute at 127 lbs. pressure.

The hose layouts for the tests were as follows:

125-lb. Test: Two 100-ft. lines of 2½-inch hose with reducing value in one line, siamezed into one 50-ft. length of 3-in. hose, with 1¾-inch nozzle.

200-lb. Test: One 100-ft. line of 2½-inch hose with 1¼-in. nozzle and reducing valve.

250-lb. Test: One 100-ft. line of 2½-in. hose with 1-in. nozzle and reducing valve.

280-lb. Test: One 100-ft. line of 2½in. hose with ⅞-in. nozzle and reducing valve.

All of this apparatus was subjected further to a rigorous road test over a 20-mile course selected to test the speed and hill climbing ability of the cars. All cars successfully completed every detail of these tests and passed the careful inspection that followed the tests.

An Adjustable, Collapsible Manhole Frame

The adjustable, collapsible manhole frame here illustrated is made to allow the lowering of the frame to correspond with the ever-changing street surface without disturbing the road materials. This frame is of Daniels manufacture.

The upper member of the frame is made to telescope with the lower portion. A part of the retaining wall is made of solid iron rings having the same circumference as both the lower section and the upper flange, where the covers rest, and these are inserted between the upper flange and the lower member.

By lifting the upper section of the frame a ring may be removed and the frame replaced, occupying the space left by the removed ring. The traffic load is carried by the rings. The grooves between the telescoping member secure rigidity sufficient to prevent any canting or tipping of the upper member, it is claimed.

The ribs on the outside of the top member sustain the demountable wall against any crowding of the road material. At the time of rebuilding the street all the rings are returned and the top of the frame is at its original level. There are

VIEWS OF DANIELS ADJUSTABLE MANHOLE FRAME.

two rings in the recess, one 1 in. and the other 2 in. wide, so that 1 in. three times may be the range of adjustment. Rings of lesser widths may be used.

The frame is made for a standard cover 24 in. in diameter, with a clear opening of 22 in. for a ladder or basket. The two pieces will weigh from 260 to 275 lbs. without the cover. The two rings weigh about 50 lbs.

Loader Skip Saves Time and Money at Rahway, N. J.

The city of Rahway, N. J., saves with two loader skips $12.40 per day in salaries, 36 hours in time and gains 27 minutes over hand loading. These skips, of the Heltzel "Lightning" type, put a full load on a 3½-ton Federal truck in three minutes, on the average. George Geisel, in charge of this work for the city, reports that the loaders make the shovelers work more steadily. The force of shovelers has been reduced one-half since the loaders were purchased.

A Compact Five Legged Derrick.

Only two guys are needed to hold solidly a five-legged derrick that is used by a midwestern contracting company. The derrick is set up on a long, narrow frame, which also holds the engine. Two side-struts, one on either side of the mast, and two backstays set at an angle of about 30 degrees from the vertical, give the necessary bracing. The pair of guys make the rig an especially solid one. It is of particular advantage where working space is limited.

ADVANCE INFORMATION ON BIG JOBS

Roads Reported to Washington by the States as Vitally Necessary to the Transportation System and as Aids to Increased Agricultural Production

Early this year it was determined by the U. S. Office of Public Roads and Rural Engineering that, so far as practicable, the federal aid funds shall be applied during the working season of 1918 only to the construction of such roads as are vitally necessary to improve the transportation system of the country, or to make feasible an increased output of important agricultural products.

The state highway departments were asked to formulate programs for the expenditure of all such funds as available for the working season of 1918 and such additional period as may be required.

The following specific information is based on the reports of many of the states to the Office of Public Roads and was sent direct to the editor of MUNICIPAL ENGINEERING by the state official named in each instance. In some cases in addition to data, convincing arguments for road construction this year are given.

Florida

Wm. F. Cocke, Commissioner, Florida State Road Department, Tallahassee, writes:

"This department has prepared fourteen road and bridge projects for submission to the Secretary of Agriculture for improvement under the federal aid, three of which have already been submitted and approved.

"The total mileage of the proposed projects is 151, with the addition of one large bridge which will cost approximately $110,000. The types of construction contemplated are sand clay, gravel, asphalt macadam and brick. The sand clay and gravel surfaces are looked upon as temporary expedients, and it is expected to supersede them with more durable types of surface after conditions have become more normal. The brick will be used at such points where no local material can be obtained.

The two main trunk line roads on which the federal aid is to be applied are Road No. 1, Pensacola to Jacksonville via Marianna, Tallahassee, Live Oak and Lake City, and the portion of Road No. 2, from Lake City to Haines City via Ocala, Leesburg and Orlando.

Illinois

Clifford Older, Chief Highway Engineer, writes:

"In the schedule we presented to the United States Office of Public Roads, we included the following projects:

"Lincoln Highway, to be built complete from the end of the present improvement in Cook county through Geneva, DeKalb, Rochelle, Dixon and Sterling, to Fulton, Ill., in Whiteside county; the entire project to cost approximately $1,620,000.

"Dixie Highway, from the end of the present improvement in Cook county, through Will, Kankakee and Iroquois counties, to the end of the present improvement in Vermilion county; the entire distance to be improved; estimated total cost, approximately $920,000.

"Chicago-Wisconsin Line, from the end of the present improvement in Cook county northerly through Lake county to the connection at the Wisconsin line with a road being built from Milwaukee to the south Wisconsin line, affording an improved road from Chicago to Milwaukee. Approximate cost in Illinois, $745,000.

"Chicago to Joliet, Ill., complete improvement to be made at an approximate cost of $396,000.

"Peoria, north, approximately to Sparland. Improvement to cost approximately $370,000.

"This schedule of proposed improvements has been approved by the Director of the U. S. Office of Public Roads."

Indiana

Relative to the matter of military and main market highways to be constructed in Indiana during the present year, Wm. S. Moore, State Highway Engineer, writes:

"We have submitted to Washington about 200 miles of main market highway, which we would like to construct this year, and have set forth in detail the amount of cars it will take to ship the material necessary to do this work.

"The Indiana State Highway Commission, as you know, has designated a system of approximately 800 miles, and we consider this system as of military value, as it not only connects up the leading centers of population of Indiana, but it also dovetails into the leading systems of the adjoining states.

"We estimate that this system of 800 miles can be constructed in about four years. We have not been able to get the Government's approval on any of this work to date (March 12), but we except to receive favorable consideration and report from Mr. Page in a very short time."

Kansas

The federal aid road work financed to date in Kansas, as reported by W. S. Gearhart, State Highway Engineer, comprises eight stretches of road, as follows: (a) West from Dodge City on Old Trails Road for 11 miles; 20 ft. brick on concrete base; (b) east from Pawnee Rock on Old Trails Road for 27½ miles; 20 ft. brick on concrete base; (c) east from Wichita 7½ miles; 18-ft. concrete; (d) Parsons to Altamont, Altamont to Oswego, west from Altamont and south from Oswego, 44.5 miles, of 16-ft. gravel; (e) north, south (two lines) and west of Fort Scott, 39 miles, of 14-ft. macadam; (f) 57 miles of 18-ft. concrete on Golden Belt Highway east of Topeka; (g) 8½ miles of 18-ft. concrete southwest of Fort Riley, and (h) the road from Beloit to Glasco. The total estimated cost of federal aid roads now financed and those for which there is reasonable prospect for financing this year is $4,000,000.

Maine

Paul D. Sargent, Chief Engineer, State Highway Commission, Augusta, writes:

"On January 30 we forwarded to the Office of Public Roads and Rural Engineering, through District Engineer Miller, the recommendations of this commission with respect to federal aid work for 1918.

"Our recommendations covered the completion of Project No. 1, which was approved last year. This covers 15 miles of construction work on State Highway Q, in Richmond, Bowdoinham, Bowdoin and Topsham. Contracts for 10 miles of this work were let last season and about 2½ miles of road were completed. The State Highway Commission has entered into an agreement with the Secretary of Agriculture to complete the balance of the work, about 5 miles, located in Richmond.

"Our second recommendation was the construction of that section of State Highway H, located in Winslow and Vassalboro, about 13 miles in length. This will give a continuous

good road from New Hampshire along the coast, through Biddeford, Portland, Brunswick, Augusta, Waterville to Bangor and nearly to Bar Harbor, which is located in the town of Eden, on Mount Desert Island.

"The section of State Highway I, located in Pittsfield, was two-thirds completed last year under a state highway contract and the balance of the work in that location will be done by the first of July. The same is true of the short section of road leading into Bangor on the same state highway.

"The work completed by the commission last year on the "Coast Route" from Brunswick to Belfast closed all the gaps but the short section in Camden, which we are trying to build the coming season. All of the road from Belfast to Bangor is good, being a gravel-surfaced state aid highway."

Michigan

Frank F. Rogers, State Highway Commissioner, writes: "We are in receipt of your letter requesting certain information relative to the data which we furnished the Office of Public Roads and Rural Engineering, regarding certain highways to be improved in this State because of their importance at the present time and under present conditions.

"This schedule has already been submitted to the Federal Government covering the roads which this department proposes to build with the assistance of Federal Aid money. These projects embrace sections of road scattered in the various portions of the State.

"Michigan's Federal Aid law, passed to give assent to the national act, contemplated using this money to a large extent in filling the gaps in important trunk lines in the state, roads such as the East and West Michigan Pikes, which are a part of the Dixie Highway; the Mackinaw Trail, running from the Indiana-Michigan State line, north through the State and connecting with West Michigan Pike at Petoskey; the through State trunk line running from Detroit through Ann Arbor, Jackson, Marshall, Battle Creek, Kalamazoo, St. Joseph and west to Chicago; the trunk line known as the Wolverine Paved Way from Detroit through Howell, Lansing and Grand Rapids to Grand Haven, and other important trunk line routes in the Upper Peninsula.

"The projects which have been submitted to the Government and those which will be submitted, cover the improvement of a considerable number of these gaps. These improvements will not only facilitate local travel, but through travel as well, inasmuch as none of these projects are on roads which are not of first importance. Simultaneous construction on these roads will bring them to completion about the same time, which under present conditions is highly desirable so that continual interference with traffic on the main roads will be avoided as much as possible.

"At present only one Federal Aid road on the West Michigan Pike is under construction. The contract has been awarded on four sections of a project located on the Mackinaw Trail in the central part of the State and construction will begin at a very early date. Bids are being asked for (March 5) on three more projects within the next month. One of these, which is probably the largest road project ever undertaken at one time in the State, is located in Baraga County in the Upper Peninsula. The road is about forty-eight miles in length and connects the copper bearing district of Keweenaw Bay with the iron mining district of Marquette County, and by means of other state trunk lines, with the iron district of Iron and Gogebic Counties to the south, known as the South Range. This project is one of the most important projects in the schedule, being of prime industrial and military importance at the present time.

"Bids are also being requested on another project on the West Michigan Pike and on a portion of the road between Ann Arbor and Jackson, known as the Territorial Road."

Mississippi

Xavier A. Kramer, State Highway Engineer, Jackson, writes:

"The Federal Aid road improvement recommended for construction this year consists of several links on the main thoroughfares through the State, principally in the following counties. Ittawamba, Hinds, Rankin, Scott, Perry, Green, Kemper, Amite, Lincoln, Madison, George, Simpson, Wilkinson, Carroll, Montgomery, Marshall, Benton, Union, Pontotoc and Lowndes.

"The approximate cost is estimated at $750,000."

Montana

Paul D. Pratt, Chief Engineer, Montana Highway Commission, Helena, writes:

"The State Highway Commission of Montana answered questions in detail as submitted by the Portland office on twenty-eight projects. The projects were divided into three classes, in accordance with the amount of progress that had been made on their preparation for submission.

"The work proposed under each of the projects specified contemplates the improvement of the existing main roads in the various counties. The improvement of these roads is considered by the State and county authorities essential in the development of the various districts affected. The State of Montana as a State has made no provision for the supplying of the funds necessary to meet the co-operation required by the Federal Aid road act. Therefore the counties in which the various projects are located have, in planning their expenditures for the year 1918, made definite plans for the appropriation of funds wherewith to furnish such necessary co-operation, and a delay at this time in the prosecution of the work in the manner contemplated will seriously inconvenience both the state department and the counties in the performance of the season's operations.

"The State has expended a considerable sum of money in the prosecution of the applications listed, and if a delay is experienced much of the work proposed will of necessity be performed by the counties unassisted, and the expense thus incurred by the State will become of no avail.

"The improvements under all of the projects are for the primary purpose of providing cheaper and better transportation facilities for the marketing of the products of the various districts, and in no case can a project be considered non-essential to the industries of the state.

"The total costs of these twenty-eight projects is approximately $596,864.22. It is desired in all cases that 50 per cent. of the cost be borne by the Federal Government, though some of these projects will not be attempted before the season of 1919 at the earliest.

"Besides the projects definitely named, applications are in the process of initiation in the following counties: Lewis and Clark, Hill, Valley, Richland, Phillips, Chouteau, Cascade, Blaine, Sheridan, Rosebud, Custer and Park.

"These last mentioned applications are temporarily delayed, for various reasons. The project statements for the same will, however, be prepared as soon as obstacles of more or less a local nature can be overcome."

Nebraska

George E. Johnson, State Engineer, Lincoln, writes:

"I have submitted a schedule to the Department of Agriculture, showing the road construction that we expect to do this year. This schedule shows that we are preparing plans for 16 projects to cost approximately $1,280,000. All of the material is on the projects, for constructing same, excepting three projects. Ninety per cent. of these roads will be earth roads, and we are constructing same to give an outlet from the farm to the market. Incidentally, these roads are on our intercounty system connecting all county seats in the State."

New Hampshire

Frederic E. Everett, Commissioner, New Hampshire Highway Department, Concord, writes:

"Our recommendation to the Office of Public Roads and Rural Engineering as regards Federal Aid projects was for proposed construction on our authorized system of trunk lines.

"Following is a list of these projects with the contemplated amounts of expenditures:

Projects located in towns of	Approximate amount of expenditure contemplated	
Seabrook and Hampton Falls	$ 16,000.00*	No. 1
Marlboro	14,000.00*	No. 2
Colebrook	13,000.00**	No. 9
Gilford and Alton	15,500.00*	No. 4
Northwood, Nottingham and Barrington	15,000.00*	No. 5
Bradford and Newbury	12,000.00*	No. 6
Danbury and Grafton	20,000.00*	No. 7
Sunapee	12,000.00**	No. 8
Hill and Alexandria	16,000.00***	No. 10
Andover	10,000.00***	No. 11
Peterboro	9,000.00***	
Dublin	9,000.00***	
Canaan and Enfield	16,000.00***	
Epsom	12,000.00***	
Londonderry	12,000.00***	No. 12
Wolfeboro	12,000.00***	
Colebrook	15,000.00***	
Seabrook, Hampton Falls and Hampton	15,000.00***	
Total	$233,500.00	

*Approved project.

**Approval pending.

***Proposed project.

New Jersey

W. G. Thompson, State Highway Engineer, Trenton, writes:

"There is forwarded to you a summary of the work in contemplation for the coming season by the State Highway Department of New Jersey.

"This includes State work only, and takes no account of work to be done by the counties. These sections of routes were selected after careful consideration of the problem as it affects war transportation, and with the idea of affording maximum aid to the military establishment. They are sections of the State highway system recently established, and which comprise some 656 miles of highways, to be taken over from the counties, constructed and thereafter maintained by the State. Of the routes shown in the following statement, No. 13 is the one included in our schedule sent to the office of Public Roads and Rural Engineering, and is the only one on which Federal Aid is requested for this year. The other routes are to be constructed with State funds raised by a state-wide one-mill tax levy. New construction work to be undertaken with State funds during the coming season will amount to about $3,000,000."

The statement to which Mr. Thompson refers follows:

"On account of the scarcity of labor and the difficulty attending transportation, it will not be possible so to concentrate as to complete any trunk route in its entirety within the year. The money should be applied, therefore, to sections of such trunk routes as will accomplish the greatest benefit to the State, as affected by the war situation.

"The manufacturing centers of the State are furnishing war supplies of various kinds; its farms are providing food supplies needed for its manufacturing interests and for war purposes; the war situation will be assisted if easy and less dangerous egress and ingress can be given to the Government reservations within the State; a direct route should be provided across the State to the port of New York.

"In view of these conditions, I recommend that moneys to be derived from the tax levy be applied as follows:

"*Route No. 1*—This route carries a large percentage of the commercial traffic from Pennsylvania via Trenton and all points south and west to the great industrial centers in northern Jersey to the port of New York. The section between Menlo Park and St. George's Avenue, Rahway, paralleling the main line of the Pennsylvania Railroad, will provide a direct, safe highway, eliminating the dangerous grade crossings at Iselin and the many sharp curves on the present road between Iselin and Rahway. As Route No. 1 is heavily traveled at night by freight-carrying motor vehicles, the above mentioned improvement will make the entire route quite safe for travel day or night.

Route No. 2—This route is the shortest line between Camden and Trenton. Paralleling the Delaware River, it would form an outlet for vehicular traffic to Trenton or to Camden and Philadelphia from the many factories located along the river. There are steel and wire mills, brick factories and various other industries whose products are very much in demand. A section of the route from Bordentown southward is therefore included.

"*Route No. 3*—This route is the main trunk line for vehicular traffic to all points in southern and southwestern New Jersey from Camden, Trenton and the north, and with its feeders and lateral connections form an outlet to the northern markets for the products from the fertile agricultural districts between Camden and Absecon. It is now carrying heavy motor truck traffic, for which the present gravel pavement is inadequate, especially during winter months. The section proposed for improvement during 1918 is that leading south from the end of present bituminous concrete pavement at Berlin to a point south of Waterford Bridge.

"*Route No. 4.*—In view of the conditions outlined above, it is believed that filling of Mullica River meadows should not be considered for 1918 work and that funds should be expended on the unpaved portion of route No. 4 between Keyport and Red Bank, thereby providing relief for railroad short haul farm and industrial traffic in the district between Red Bank and the shipping points on Raritan Bay and contiguous waters. This, with contemplated improvements outside the State Highway system will also relieve and facilitate vehicular movement from and to Fort Hancock and Sandy Hook and adjacent territory.

"*Route No. 6.*—This route forms an oulet for the productive agricultural region in Gloucester, Cumberland and Salem Counties, for supplying of food products to the densely populated centers of Camden and Philadelphia, which with the development of the shipbuilding industry along the Delaware River and consequent increased transportation requirements, will tax the railroads to the utmost during the coming year. A steady stream of food laden vehicles travels this road, which at present needs improvement, warrants improving the section between Mullican Hill and Woodbury.

"*Route No. 9.*—This route provides the shortest line for vehicular traffic between Phillipsburg and all of its neighboring industrial actfvity and the industrial centers of Newark, Jersey City and the shipping points on the Hudson River and the New York Bay. Grading and paving of the only unimproved section of the route, namely over Muscanetcong Mountain between West Portal and Perryville, is desirable. With this improvement a means will be provided for rapid vehicular communication between the steel manufacturing center of South Bethlehem, Easton and Phillipsburg, and the factories of Somerset, Union, Essex, Hudson and Bergen Counties. The absence of such improvement makes the route practically valueless for traffic at present.

"*Route No. 10.*—Inasmuch as there are at present only two approaches to the Hudson River from the densely populated and highly important industrial centers of the Passaic and Hackensack Valleys, both of which are now overburdened, one of which has sharp turns and prohibitive grades, the con-

templated improvement of the section of route No. 10 from Fort Lee Ferry over the Palisades to Anderson avenue is of great importance. It will provide a maximum grade of 7%, as against 13% and 16% on one of the existing routes. The motor truck traffic over these roads between the Passaic Valley and the Hudson River ferries in Bergen County is possibly the heaviest in the entire state, and considering the growing inability of railroads to cope with ever-increasing freight, will increase rapidly in volume and weight of loads carried. It is, therefore, very apparent that the importance of the improvement of this section of the route cannot be overestimated. It will afford connection to the upper New York harbor for the cantonment at Camp Merrit and lower plants in the northern and northwestern section of the state.

"*Route No. 13.*—The improvement of that section of route No. 13 between Kingston and New Brunswick will bridge the existing gap in existing pavements between Trenton and New Brunswick, thereby providing a direct, well-paved highway from the industrial centers adjacent to Trenton and the Delaware River to New Brunswick, thence by existing well-paved roads to the manufacturing centers north and east. This route being a part of the Lincoln Highway is well known and, therefore, heavily traveled. It is also the most direct line between Philadelphia and the Hudson River. Because of its present condition and the necessity for immediate improvement brings it within the work to be done during 1918.

"*Route No. 14.*—This route forms the only outlet for vehicular traffic from the United States Naval Station at Cape May. The existing gravel pavement has eight railroad grade crossings within four miles. A number of deaths and serious accidents have occurred during the past two years which render the elimination of these crossings of primary importance. The improvement of this section will provide a hard pavement, making the naval station accessible at all seasons of the year, and obviate the present dangerous conditions from Cape May City to a point known as the Sally Marshall Crossing."

Rhode Island

I. W. Patterson, Chief Engineer, State Board of Public Roads, writes:

"Two sections of state highway are planned to be built under the Federal aid road act during 1918.

"Both of these sections are upon the Shore Line route between Providence and Westerly, which highway forms a portion of the Atlantic Highway, so-called. These two sections of road are almost prohibitive to travel for a short time each spring. These two sections, furthermore, are the only sections between Providence and Westerly which are really bad at any season."

Tennessee

A. M. Nelson, State Highway Engineer, Nashville, writes:

"The work designated by the State Highway Commission in the schedule furnished the Federal government entails the improvement of roads No. 1, 2, 3, 4, 7 and 18, which gives us a connected road from Memphis to Bristol and from the Kentucky state line to the Georgia state line across the state of Tennessee respectively east and west and north and south.

"This is our program for construction for the year 1918, to complete the uncompleted portions in these two roads across the state in both directions."

Utah

Ira R. Browning, State Road Engineer, Salt Lake City, writes:

"Herewith are extracts of our recommendations in connection with Federal post road projects in this state during the current year:

"*Project No. 1.*—Castle Gate-Duchesne road:

"Length of miles to be improved, 45 miles.

"Present type of surface, earth, shale and gravel.

"Present condition, passable for light traffic and loads up to about two tons, except during the spring thaw or stormy periods.

"Proposed type of surface, shale, gravel and sand clay surfacing.

"Approximate total cost, $77,400.

"Approximate amount of Federal aid desired, $38,700.

"Materials to be hauled in by rail, 220 tons of Portland cement, 116-mile rail haul; 5 tons of corrugated iron culverts, 126-mile rail haul.

"Relation of proposed road to other important roads in affording needed transportation facilities—Connects the Midland Trail at Castle Gate with the Heber-Vernal road at Duchesne. Provides the principal outlet for a producing area of more than 100,000 acres of irrigated land and more than 1,000,000 acres of grazing land.

"Volume and character of present traffic, United States mail, parcels post and freight averaging about 110 tons per day passing over this road, also average of 25 passenger automobiles each day.

"Probable change and increase in traffic to follow construction, outgoing freight, including wheat, oats, potatoes, hay, wool, honey and other farm or ranch products, should double immediately after road construction is completed, and all traffic will have a substantial, steady increase.

"The definite purposes to be served by the proposed improvement, afford marketing facilities for farm and ranch products.

"The possible bearing of the proposed improvement on the war situation, will make available for rail shipment thousands of tons of foodstuff that could not otherwise be shipped profitably.

"Probable effect of delay in construction to the 1919 working season or later, retardation of development of this producing section and preventing a large tonnage from being marketed.

"Further remarks by State Highway Department, the State Road Commission pledged this road improvement if the farmers would take steps to increase production. The farmers are doing their part.

"This project is the only one as yet approved and, therefore, is the only post road project participating in Federal funds at this time. Other projects are generally of the same type as project No. 1 and are justified by nearly the same arguments, but with varying acreages and tonnages involved."

Washington

George F. Cotterill, Chief Engineer, Olympia, writes:

"The Washington State Highway Department has complied with the request of the Federal Bureau of Public Roads and made detailed answers to the questionaire on the schedule forms furnished. Detailed information was furnished on 12 post-road improvements now ready for progress as our 1918 construction program. These cover about 65 miles of permanent highway improvement, estimated to cost $450,000, of which $235,000 is available from state funds and $215,000 from the Federal post-road allotment to this state for the coming fiscal year.

"These twelve projects cover in every instance important 'missing-link' sections of 1 to 18 miles in length each on routes of trunk highways which have been established as the state system and upon which about 1,500 miles of systematic construction has proceeded during the past six years. Several of these sections are of strategic need as parts of military roads and all are of high economic value as serving food supply localities or as alternatives for railway transportation routes by use of motor trucks.

"This department has presented the importance of each of these pending projects and urged that there be no postponement of any of them. In the letter transmitting the schedule form answers covering these twelve projects in detail, it was stated by the State Highway Commissioner that:

"'I desire also to impress the fact, which applies to all these projects, that the state and county co-operating funds are already in hand and in several cases have been held over since last year. There can be no use of any of these funds for other purposes, no saving to taxpayers and the only effect of delay would be to hold these funds in their places of deposit out of use.'

"An independent investigation, with the idea of possible postponements or eliminations, was also conducted by Federal authority during February, covering our 1918 program for projects within and adjacent to national forests under Section 8 of the Federal aid road act. For reasons unnecessary to review no actual construction had been begun on any of these projects during 1917, hence the entire program is already one year behind.

"Nine projects, involving 68 miles of construction in sections of 2 to 12 miles length, making extensions and filling gaps in our state trunk highway system (crossing national forests on the Cascade and other mountain slopes between productive vicinities and their markets) have already received formal or tentative approval at Federal hands. Their estimated cost totals $500,000, of which $265,000 is available state and county funds (mostly held over from 1917 and all now in hand and usable for no other purpose) with $235,000 of Federal aid apportionment for the two past fiscal years and that commencing July 1, 1918. Most of these projects have been deferred from 1917 and all are ready for progress with the opening of the 1918 working season.

"While there is some difference between their relative importance, all have ample merit to justify immediate progress, and should only be postponed in case of demonstrated need for the labor, capital or facilities necessary for the acknowledged superior war supply requirements. The details as to each of these projects were thoroughly presented to the Federal authorities during February.

"Summarzing as to both classes of Federal aid improvements planned for the Washington 1918 construction program, the facts have been given to the Federal authorities which in our judgment demonstrate:

"1. That each of these 21 projects is on some main trunk highway established as part of the comprehensive state system, upon which consecutive construction has proceeded for six years to the extent of about 1,500 miles, fairly distributed over the large area of the state of Washington, and the highest usefulness of previous construction and other improvements now progressing from state and county funds is dependent upon the prosecution of these 133 miles of Federal aid projects.

"2. That only a slight percentage of materials requiring use of railway facilities will be necessary for these projects, practically all construction being from local materials not requiring any railway haul.

"3. That there is ample construction equipment, teams, etc., available for this work during 1918.

"4. That if all these projects proceed during the 1918 working season as planned, they will not require unitedly a working force at any time exceeding 2,000, and not averaging more than 1,000 throughout eight months; that this number of road laborers out of a total of at least 300,000 male workers in the state is such a small percentage as not to affect materially the labor situation; that the workers available for road work are of an age and class not under any call for military or naval needs or adapted for shipbuilding or other mechanical employment; that the rate of pay for unskilled road labor cannot by any possibility attract from any necessary industrial or other war supply work, except possibly some forms of agricultural labor, and if any emergency—as, for instance, during the harvesting season—should demand the service of these men they would be more readily available for that purpose if already mobilized on public work at known points close to our agricultural needs than if they had to be gathered and brought from scattered places of idleness. The ability to suspend public road work and transfer labor for any possible war supply emergency is an argument of itself for assembling labor on road work rather than for postponement.

"5. That the total of $500,000 of state and county funds, already taxed and collected from our people (and most of it lying idle in banks since last year), cannot be applied to any other purpose, but must await the $450,000 of agreed Federal aid for its co-operative expenditure; that unless the Federal government requires the use of this appropriation fund for superior war needs, there is no adequate reason for postponement of any of these projects."

Wisconsin

A. R. Hirst, State Highway Engineer, reports that the proposed Federal projects for this year total about 190 miles of earth work, about 70 miles of gravel, about 19 miles of bituminous macadam and about 45 miles of concrete or brick.

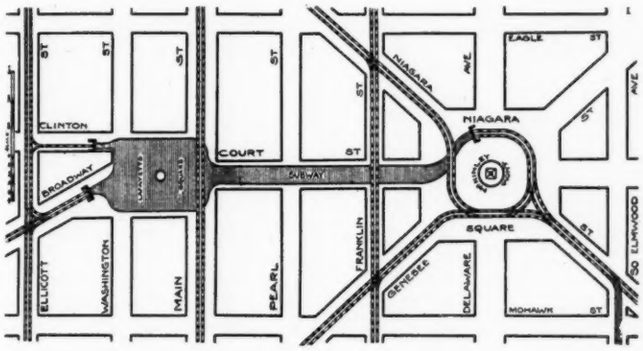
The Proposed Street Railway Subway Terminal for Buffalo, N. Y.

As one measure for relieving street congestion in Buffalo, N. Y., there has been proposed a street railway subway terminal. This sub-surface trolley terminal is proposed by the Traffic Ordinance Committee, of which City Engineer George H. Norton is a member. Its essential features are here illustrated and described.

The present central congestion, while somewhat due to the slow movement of numerous cars over extensive routes to facilitate convenient transfer, is mainly from the stopping and standing cars loading and unloading passengers. The street areas necessary for concentration of passengers adjacent to the cars is entirely lost as available for vehicular traffic, and the conflict of these two uses is largely the cause of the many street accidents. Could areas be found where this loading, especially of through or transfer passengers, could be made without highway obstruction, material relief would be given.

Conditions Indicate Need of Sub-Surface Terminals

These considerations point to terminals not situated on the surface of the thoroughfares. Some such terminals have been installed in various cities with good results, but where located on private property adjacent to busy streets the congestion caused by passage of many cars from street tracks into and out of such terminal buildings is destructive to all street travel in the vicinity.



PROPOSED STREET RAILWAY SUBWAY TERMINAL, LAFAYETTE SQUARE AND COURT STREET, BUFFALO, N. Y.

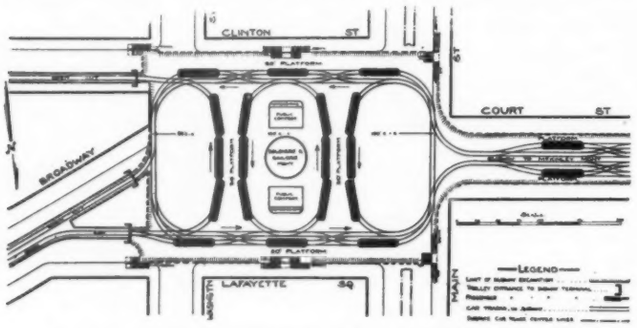
The ideal system would be for the cars to leave the surface tracks outside of the congested districts and pass to and through the terminals without obstruction of streets. This leads naturally to construction either above or below the street surface.

Influence of Topography

The peculiar topographic formation of Buffalo, where the main street congested district is materially higher than the territory on either side, points to a sub-surface terminal as most logical.

At present it does not seem warranted to make such terminal adequate to care for all cars in the central section, and the topography indicates the desirability of taking the east and west lines into such terminal and operating the north and south lines at grade over such depressed terminal.

The logical plan resulting from all these considerations seems therefore to be to operate the Elmwood avenue and Franklin street lines, Main street, Ellicott and Elm streets as



INTERIOR PLAN, SHOWING GENERAL SCHEME FOR CAR OPERATION, PROPOSED STREET RAILWAY SUBWAY TERMINAL, LAFAYETTE SQUARE AND COURT ST., BUFFALO, N. Y.

grade lines and to depress into a subway terminal the various Niagara street lines from the west, all suburban cars, and the radiating east side lines, Best, Genesee, Sycamore, Broadway, William and Clinton street, and perhaps some of the southeasterly lines.

The Plan

To meet the present conditions the following plan is proposed, its subsequent enlargement to meet increasing demands being outlined below.

The terminal to be located under Lafayette Square, utilizing the space from the westerly curb of Main street to the easterly line of Washington street and the full width of the square.

This construction can be so made as to in no wise interfere with the present appearance or use of the square, and would improve it to the extent of the removal of the car tracks now in Broadway and Clinton streets, between Washington and Main streets.

It will not be necessary to disturb the Soldiers' and Sailors' Monument as now erected, as the car loops here proposed would circle the existing monument and foundation and would not disturb the same.

The easterly entrance to this terminal to be by depressing the Broadway tracks from the westerly line of Ellicott street, passing entirely under the surface east of Washington street. The extra width of this street and the large natural slope from Washington to Ellicott street make this entirely practicable and easy without damage to abutting property. A single track branch outlet along the northerly curb line of Clinton street could be constructed and leave better surface conditions in this congested block between Washington and Ellicott streets. This terminal would be connected with the west side lines by a four-track subway through Court street to Niagara Square, the tracks rising to grade around the southerly and westerly sides of the monument by double track and meeting the existing grade tracks of the Niagara street line at the northwest corner of the monument space. These tracks would be not more, but rather less, obstructive to the view of the monument than existing surface tracks, as the cars would be below sight over a considerable portion of the distance.

This arrangement meets the requirements of getting terminal cars under ground without material obstruction of highways and allows continuous cross-town operation without interference with surface traffic in the congested district.

The location is the most central from the general geographical structure of the city and probably for traffic desiring to reach the heart of the city. The general plan of operation would be for several radiating east side lines to converge on Broadway at Ellicott, or beyond, pass into the tunnel, make a short loop and pass out by a similar route. West side cars converging on Niagara street, at the square, would pass into the subway at the monument and under Court street, make a short loop in the terminal and pass out by the same route. If found advisable, one or more of these lines could be made continuous between the east and west sides, passing through the terminal. Stairways on Main street and Franklin street would allow for transfers from these cross lines to the north and south lines at these points.

Future Development

This outlined plan should provide relief sufficient for some years, but can be readily extended. When the space under Lafayette Square proves inadequate, then a similar subway station can be provided under Niagara Square, some east side cars passing to this loop, west side cars passing to Lafayette loop, which will be possible over the four-track Court street subway. The next extension would be by subway in Main street or parallel street from Court street to a loop terminal at the Terrace for railroad station connection and transfer to the southeasterly lines, with a possible connection through Niagara street from the square to Main street subway.

A comprehensive study which has been made of the city plan strongly indicates the advisability of widening Clinton street as a great connecting arterial thoroughfare. There is, as a possibility, the construction of railroad passenger terminal facilities in the vicinity of Fillmore avenue. In case of such construction, reasonable transportation facilities would demand a subway connection with the heart of the city, and such might then be readily furnished through Clinton street to this proposed terminal.

These enlargements should be sufficient for all demands until such time as the growth of the city demands a general outlying subway system, of which these terminals would form a part.

Details

General studies indicate that the Lafayette terminal could provide space for simultaneous accommodation of 15 or 20 cars. As these cars would be arranged for loading from ground, as at present, it would be necessary to avoid raised platforms, etc., in the terminal. Prepayment of fares and issue of transfers would be made at a gate system on entrance and cars be loaded and unloaded through all doors, thus materially shortening the standing time in the terminal. No transfers would be necessary between lines entering the tunnel. Shelters should be provided at Franklin and Court and Genesee and at Shelton Square, with adequate public comfort stations. These arrangements would largely eliminate exposure to inclement weather in transfer and waiting for cars, now just cause for complaint.

The Proposed New Orleans Industrial Canal and Lock

By Howard Egleston, Engineer and Manager, Industrial Bureau, New Orleans, La.

Two conditions, one physical and one legal, have heretofore prevented New Orleans from becoming a great manufacturing city. The annual flood of the river furnishes the physical cause, and the organic law of the state, which makes all water front in towns and cities public property, furnishes the legal cause. The river rises at flood times about 20 ft., this has

made necessary the construction of great levees to protect the surrounding country from inundation. To protect these levees, the state has given power to the Levee Boards to expropriate any property that may have been erected on the water front. Under these conditions no industry could afford to build on the water front, and such as could be successfully carried on only in such locations, have gone elsewhere.

Canal to Connect Lake Ponchartrain and Mississippi River

This condition has been fully recognized for many years, and the Association of Commerce has constantly striven to carry through some plan that would give a sea level water front that could be permanently occupied. As a result a measure was brought before the legislature in 1914 and enacted into law, which authorized the Port Commissioners to construct a canal from Lake Ponchartrain to the river and connect with the latter by means of a lock.

$4,500,000 Available

Then came the war, and the Port Commissioners felt that if they completed the great cotton warehouses and built the new public grain elevator, they would be doing as much as was warranted, under financial conditions. But the demand for ships brought a demand for yards to build them in, and as shipyards cannot be placed on the banks of a river that rises periodically 20 ft. above its normal level, the plans for an Industrial Canal and ship basin into which ships could be launched any time, came to the fore again. The interest of all commercial organizations was aroused with the result that a financial plan has been worked out, and a contract made with a group of bankers by which the Port Commissioners have at their command $4,500,000 with which to construct the canal and lock.

The Lock

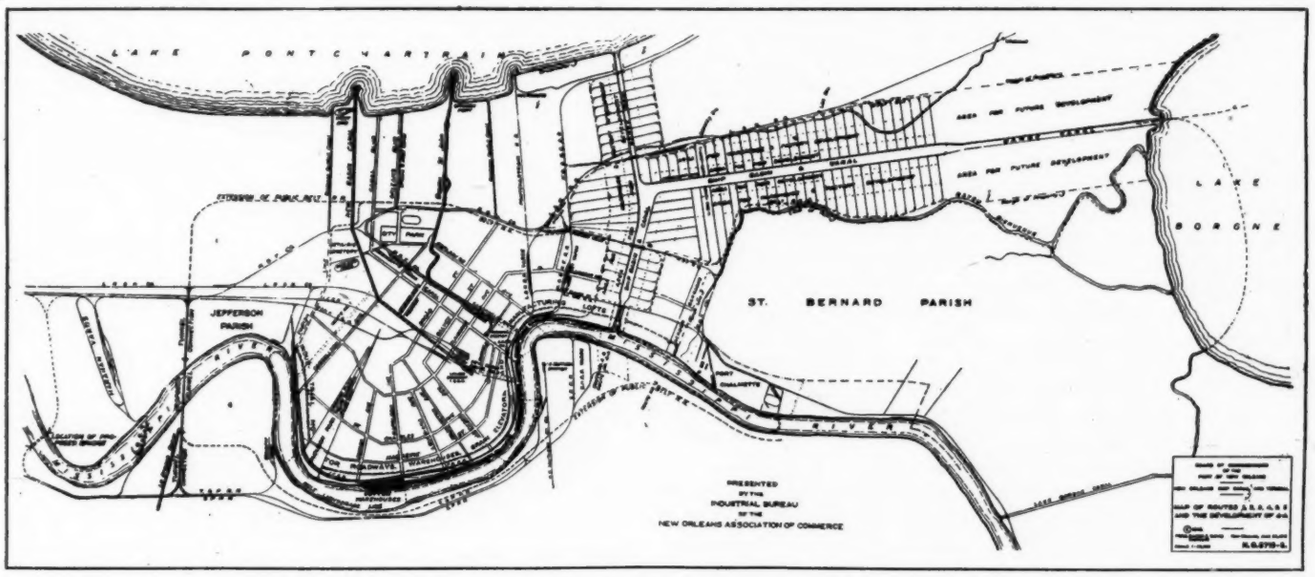
The canal will be located in a part of the city that has not been built up, though that portion of it near the river has all the city advantages of sewers, water, gas, electric light, street cars and telephone and will form a desirable residential location for the workers. As the reason for building the lock and ship basin is to get a location for shipbuilding, it is planned to make the locks only large enough to allow the passage of the standard steel ships the Government needs now, the intention being to enlarge the lock and canal so as to take in the largest ships that enter this port, at some time in the future when conditions warrant the expense. This may not be the wisest thing from a business point of view, but it is good patriotism.

The present tentative plan is to construct a lock 600 ft. long, 70 ft. wide, with a depth of 18 ft. at low water, over the sill of the lock. This depth will be the same in the canal as far toward the lake as may be necessary. The canal property at the lock, and extending for a mile or more, will be at least 800 ft. wide and the balance of the way to the lake, at least 300 ft. wide.

Main Canal 5.3 Miles Long

All the work of constructing the lock can be done before the water is let in, thus insuring better and quicker work. The work of excavating the canal from Lake Ponchartrain toward the river will be carried on by a large number of dredges while the construction of the lock is in progress, and at the same time, ships will be built and warehouses and shops erected. The canal will at first only extend from the river to the lake, a distance of 5.3 miles, but later on, a lateral extension of something like 8 miles will be constructed from about midway of the distance between lake and river to the east until the waters of the gulf are reached at Lake Borgne.

The completion of the canal from river to lake will give over 55,000 ft. frontage on the water, which may be increased to any extent by the construction of lateral canals. Thirteen thousand miles of waterway will bring the products of the fields and shops and mines of 21 states, containing 49 per cent of the total area of continental United States, to industries located on this canal, and make possible the export of finished products, at the lowest possible cost, to all parts of the world.



PROPOSED SHIP CANAL AND TERMINAL FOR THE PORT OF NEW ORLEANS.

$20,000,000 for Water Power Development at Muscle Shoals, Ala.

A water-power dam to cost from 15 to 20 million dollars will be constructed at Muscle Shoals, Ala., according to an order recently signed by President Wilson. The War Department was ordered to proceed at once with work on the project, which is a part of the plan for the construction of a government nitrate plant for the fixation of atmospheric nitrogen to be used in manufacturing munitions and fertilizers.

The dam site has been offered to the government without cost by the Alabama Power Company, which already has a contract to furnish 35,000 horsepower to the Muscle Shoals nitrate plant by June 1. The company has also agreed to transfer options on about 75 per cent. of the land which will be affected by the overflow from the dam.

The navigation of the Tennessee for the greater part of its

course is assured by the construction of the dam at Muscle Shoals, and this is expected to aid largely in the future use of the nitrate plant. The raw materials essential to the manufacture of fertilizer are all close at hand. Phosphate rock, limestone, coal and coke can be had in abundance, and water transportation will be available.

The total development proposed is 680,000 h.p. The initial development will generate 150,000 h.p.

Reports state that the power dam will be one mile long by 105 ft. high and that it has not as yet been determined whether to build by day labor or contract. Three years will be required to complete this power development, and pending its completion a 100,000-kilowatt, steam-driven electric plant will be built by the government to supplement 35,000 h.p. which the Alabama Power Company, of Birmingham, will furnish. This company's transmission system is now being extended and will be ready to supply Muscle Shoals by June 1. Surveys are progressing for the dam, and preparations are being made to begin construction, which will include an industrial city for the constructing workmen as well as for the permanent employes who will locate. Col. Charles Kelly, U. S. A., will locate at Muscle Shoals as engineer in charge of the power plant construction.

GENERAL ARTICLES

Procedure in Office of Construction Engineer, Employing Small Staff, Supervising Expenditure of $2,000,000 for New Improvements

By H. W. Skidmore, Construction Engineer, Department of Public Works, Oak Park, Ill.

In the four years just past Oak Park has spent $2,000,000 for new improvements—pavements alone costing $1,326,146.45. With a present population of 35,000, it would at once appear that Oak Park has been in the front ranks among cities of that size in the matter of public works.

This large amount of work has been handled by the department with a minimum number of men at a low cost. To do this it was absolutely necessary to weed out the non-productive individuals and to put each phase of the work on a high plane of efficiency. This has been accomplished in spite of low salaries, "old-time" inspectors, etc. We have made our mistakes, of course, but a high standard of work has been maintained.

We have made many improvements in field and office methods during the past three years. The procedure in the construction engineer's department may be discussed briefly under the following heads:

Inspection

A comprehensive system of daily reports, which supply accurate information concerning all stages of the work; give locations, quantities and character of work done and materials used, contractor's force and rates, daily labor and material costs, etc., has been maintained and constantly improved. These reports are brief and ask for only such information as is really valuable now and later. They do not demand so much of the inspectors' time that his mind is distracted from his prime duty—seeing that the work complies with the specifications. These reports have been found to serve several purposes, viz., they supply the office with a permanent record of what transpired on the work; they provide accurate data from which to compile statistics, and they furnish records of underground work, which is in turn posted on the proper atlas, etc. Records such as these, when analyzed and compared with those of other jobs, contractors, etc., give us a keener insight into the efficiency of the various contractors and the character of the work done by them. They also serve as one means of "sizing up" the inspectors, since intelligent, accurate reports demand wide-awake, intelligent inspectors.

Inspectors are employed on each separate stage of the work, such as curb, grading, concrete base, etc. Inspectors showing particular adaptability to certain kinds of work are kept on such as much as possible. The force has been gradually rid of the less competent members, salaries have been raised and under close supervision a very efficient organization has been built up.

Frequent meetings of the entire force are held, at which times matters of both special and general nature are discussed, suggestions made and instructions issued, aims and methods defined, etc. Inspectors also attend the regular monthly meetings of the entire public work department. As a result of this practice the men have gained a thorough working knowledge of the various activities and regulations of all the departments, and consequently have rendered much co-operation in the matter of reporting irregularities and violations of ordinances and rules.

The writer, in co-operation with the chief inspector, has compiled and written a book of instructions and regulations for the use of inspectors and field men. This book is made in loose-leaf style and can be added to or changed at any time. It has been found to be of great value in the field, as it is well-nigh impossible for one to remember the practice in every case that may arise on a job.

Inspectors are provided with stars as a means of identification, and by virtue of these are enabled to command more respect when issuing instructions or warning violators.

Field Work

This work is done under the direction of the construction engineer, and comprises all preliminary surveys, field work during construction, final surveys and measuring, etc., which is incident to improvements; all field work necessitated by public uitlity construction and maintenance, park improvements and all field engineering connected with the activities of the Public Works Department in general.

The loose-leaf system of notes is used and has given excellent satisfaction because of accessibility of data concerning any given job and ease of filing; only one field book containing just the notes desired need be carried and any given set of notes may be left in the office for checking, extending and inking, without having to leave a bookful of other notes which may be needed in the field.

All preliminary and final work in connection with pavements, sewers, water supply, etc., is very carefully done, so that the resulting records eliminate any element of guesswork in designing and estimating and leave no room for doubt regarding quantities, location, etc., of completed work.

The field party is furnished with an automobile. This has enabled one party of from three to four men to handle as much work during the busy season as would otherwise require two to three parties.

Daily distribution is kept and yearly analysis is made of all field work.

Drafting

All the drafting work required by any of the departments is done in this office. One draftsman, who is also capable of doing instrument work, is employed all of the time, and during seasons of extra heavy work a second man is employed. We also make it a point to employ instrument men who are capable of doing some drafting and utilize them during bad weather and part of the winter months.

Preliminary or study plans are made for each job. Street lines and profiles are inked in, the other data being penciled on the tracings. After the layout and design has been made and the plans approved by the Commissioner, this study plan is made into a working plan, all of the information which was penciled on originally is now inked in. These working plans show all the details. After the ordinance has been passed a second plan is made, which does not show all of the details needed on the working plan. This plan is used in the county court at the time the assessment is confirmed. It has been found advisable to make this second plan in order to avoid the thousand and one questions that really have no bearing on the merits of the work in question, yet seem to afford the opposing attorneys much opportunity for delaying and even at times securing the dismissal of the improvement.

Final plans, which constitute a complete record of everything above and below ground, are made upon the completion of all work. The various atlases are also kept posted as the work is completed.

Daily distribution of drafting work is kept and analyzed at the end of the year.

Street Openings

The mileage of permanent pavements is constantly increasing and in direct proportion thereto is the increase in the number of openings in pavements. The economy of systematic regulation of pavement openings is well recognized by the profession today, and many cities have taken care of this feature in a very satisfactory manner. Until recently the practice at Oak Park was not very comprehensive, therefore, one of our first problems was here presented.

The methods and regulations employed by many other cities were investigated; the problem as it concerned Oak Park alone was analyzed, and then a report was made to the Commissioner of Public Works, pointing out wherein the existing methods could be improved and what new forms, regulations, specifications, etc., were needed. The report was adopted by the commissioner and is in operation today, though some of the minor details have not been fully worked out, and slight changes are made from time to time. It has been found that considerable educating of the public was necessary before any such system could be made to produce the desired results.

The matter of investigation, specification, regulation, inspection, repairs, records, etc., has been placed under the charge of this office. Since the engineering department is responsible for the building of pavements which will meet the requirements of modern traffic, it would seem that it should also have charge of the matter of opening those pavements.

Except in the case of macadam pavements (and not always then) we do not allow the permitee to make the final repairs to the pavement, unless it be an extensive piece of work which is being done by some public utility company, in which case we would allow them to do the work under our specifications and inspection. All repairs made by the Street Department are subject to the supervision of the office except as noted.

We employ one inspector who gives this work his entire time, if it is required. Such others as are needed from time to time are supplied from the regular force employed on new work. The nature of this work demands a very high-class man, because of the good judgment, accuracy in matters of locations and records, wide experience in all kinds of paving work, integrity, energy, etc., which experience has shown are absolutely necessary for proper handling of this very important part of the work.

Each opening made is insured against future settlement by thorough tamping and puddling of backfilled material (when excavated soil is not considered proper material for backfilling, cinders, sand, gravel or fine, dry earth must be secured for the purpose); by replacing concrete base, not less than 12 ins. thick, with bearing of 12 ins. on solid earth entirely around the opening, rich mixture—about 1:2:3—is used for all repair work, and reinforcing rods are specified at the discretion of the engineer. This practice is also followed in treating recently excavated trenches prior to all paving construction. We have never found that any trenches so treated have settled after the pavement was laid; however, before this method was adopted we experienced considerable maintenance due entirely to settlement of improperly reinforced trenches.

Fees charged for permits to open pavements are ample to cover the cost of repairs, inspection and other overhead.

Inspection of Asphaltic Pavements

Each year two very thorough inspections of all asphaltic pavements are made with the view of studying different types, under various traffic conditions, work of different firms, various materials used, etc. We have been, also, studying asphaltic concrete pavements in particular with regard to the decided tendency of such to crack. These inspections have shown conclusively that at least 98% of the cracks in surface material meant a crack in the concrete base, either directly under that in the surface or very close to it. We have found no cracks in this type of pavement laid on macadam base, and also found that sheet asphalt pavements do not crack as much as do asphaltic concrete, which fact we believe is due solely to the presence of a binder course.

The results of these inspections are posted on standard forms which include all the asphaltic pavements in the town, and give a complete history of each pavement from the time it was laid up to date. The inherent value of such a comprehensive record for the purpose of analysis and comparison is at once apparent.

Traffic Census

A traffic census has been taken on several of the heavy traffic thoroughfares, and will be taken on some of the other streets as well. These surveys will be repeated from time to time, for the purpose of studying the character of traffic, its frequency, changes, etc. This data, of course, will be used in designing future pavements.

Testing Materials

A small testing equipment was installed at the beginning of last year's work. It has proven to be a very valuable investment. Prior to that time much of the testing was left to the judgment of inspectors, and all of it was done by outside engineers. Owing to the cost of having this work sent outside the office, oftentimes analyses which probably should have been made were not considered important enough to warrant the cost.

While no elaborate analyses are attempted, only the simpler tests being made, still we have readily seen the value of such in the character of work done during the year. All analysis work incident to asphaltic pavements is handled by Mr. Lester Kirschbraun, Director of the Chicago Paving Laboratory.

In these days of rapid progress in all fields of construction work, intelligent analysis of materials, both in the laboratory and in the field, is proving to be a decided factor in insuring the best quality of work.

Card Record of Street Repairs

A system of card records of all street repairs, except macadam repairs, which are recorded by the Street Department, has recently been completed. These cards include repairs necessitated by street openings, general repairs and reserve maintenance. Each card gives complete data, such as location, size, kind of pavement and base, names, dates, etc.

While this record was very tedious to prepare, owing to the sad state of neglect in which we found the old records of some years back, once it was brought up to date, it has been found to require a surprisingly small amount of labor for maintenance.

Sewers

Many years ago, when Oak Park was a part of the town of Cicero, its sewers were designed as a part of the system which now drains several separate towns. The original design was made by a very capable engineer, who applied the then best-known principles, but many subsequent departures from the original plans were made by the various men who happened to be employed by the town from time to time. Then, too, at that early date not even the best sanitary engineer could have dreamed that Oak Park would develop as it has. Consequently our sewers are not of sufficient capacity now.

Until recent years sewers were built as needed, no particular attention being given to the compliance with any comprehensive scheme. They were simply given whatever size and gradient seemed to fit in with the existing sewers. The error of such procedure was at once apparent, for, even though some of the sewers built many years ago would never be able to serve the future, extensions which were to be made should have been designed to fit in with a scheme which would provide for some future relief plan. No rainfall or run-off data was available; in fact, the files for several years back disclosed no evidence that any theory had been applied to the design of sewers.

Consequently one of our first tasks was to collect rainfall data and compute run-off rates, etc. This was done and all the sewers which have been built in recent years have been designed large enough to serve future requirements and to fit in with a plan which the Commissioner of Public Works and the writer have had in mind for some time, for the relief of our congested system. Recently the writer made an exhaustive analysis of the situation.

During the course of construction of various improvements in recent years evidence of inferior workmanship and apparent very careless inspection or none at all, has been uncovered many times. This class of work undoubtedly supplies one of the reasons why some of our sewers are so entirely inadequate.

Pavements

It is a significant fact that 85% of our roadways are paved and that about 32% is with asphaltic concrete. This type of pavement has met with considerable popularity among the property owners, because of its economical first cost and maintenance, its sightliness and cleanliness, and because of being practically noiseless. Experience has led us to believe that in some cases at least it would probably be better engineering to provide a bituminous base for this type of wearing surface, because of cost as well as in order to do away with the cracking tendency. A special mixture which was developed several years ago by Mr. Lester Kirschbraun and the Commissioner of Public Works is used and has given such good results that several other towns have adopted the specification.

All the brick pavements laid during 1917 were specified to comply with what is known as the monolithic type. On the first job laid we tried to live up to the letter of the specifications, but on those which followed we allowed the concrete to get its initial set, then laid the wire-cut block on a cement-sand bed. Because of the width of pavement, the great number of men who must walk back and forth over the work, and many other items of "workability," we have decided that the purely monolithic type, while its merits are not questioned, nor is its adaptability to the narrower highway pavement, is not best suited to the city street pavement of a varying cross-section, and laid by the present-day city paving contractor's organization, which is naturally much larger than that of the highway contractor, and owing to present-day labor conditions must be held intact for other work. Our specifications have, therefore, been changed to cover the cement-sand bed type of construction.

We have been laying a 6-in. concrete pavement in alleys with much success. These pavements are finished by means of the roller and belt processes. A few reinforced concrete pavements have been laid, but we are inclined to think that where the traffic is sufficiently heavy to demand this type of pavement a brick pavement should be specified.

It is interesting to note that the cost of maintaining pavements has been showing a marked decrease during the past few years. This is, of course, due to the replacing of macadam pavements with permanent structures. Also it is partly caused by the very large proportion of new pavements within the last four years; these new pavements naturally will not require much repairing for several years. Also it must be remembered that once these pavements do begin to show signs of wear and need some attention, such repair work will be evenly distributed from year to year, and will undoubtedly cost less per mile per year than the present rate, which still includes the maintenance of some 27 miles of old macadam roadway.

Inspection has been very close during the past four years and the result of this is readily seen in the class of pavements which have been and are being laid.

General

The several tables, charts, summaries, analyses, etc., which are prepared, are undoubtedly of value to the office in many ways, i. e., the analysis and summary of inspection costs on paving work is only an instance of such. These tables offer conclusive proof of our contention that those contractors who have incurred the highest unit inspection costs invariably do a poorer grade of work than those who, by good management, complete a given job in record time, thereby minimizing such cost. Such data as this is valuable as a permanent record of the year's work, and also of the work of successive years. It provides a mean of comparing the various contractors, and in many other ways offers valuable data to be used in the planning of field work, etc.

And so with much of the other data compiled. If such records were valuable only as a permanent record they would undoubtedly be worth the effort, but once such information is recorded and studied many unforeseen values are discovered. Moreover, the engineer in preparing such records gets a better idea of what he has been doing throughout the year, the results obtained, where improvements can be made, and so on.

In making improvements in old methods and in installing new ones, we have kept in mind that systems of records to be of value now and later must be maintained, and in their upkeep must not incur labor which cannot be handled by the regular force. It has been found that in working out some new scheme for doing this or that, while new duties were created for its upkeep, yet the maintaining of the scheme had so facilitated other office routine that in the end we had more time for new things. While "system" can be overdone, and its ramifications become so extensive that a top-heavy organization would be needed to keep things up to date, yet a certain amount of system and accounting of facts and figures will be found to be a blessing to many an engineering office.

Oak Park has existed as a municipality 16 years, having drawn away from the town of Cicero in 1902. During the last eight years it has doubled in population; the various activities of and demands upon the Department of Public Works have increased from 100 to several hundred percent, and many new activities have been taken on by the department, especially in very recent years.

In closing it is a pleasure to acknowledge the assistance received from other departments making up the Department of Public Works, without whose hearty co-operation it would

have been impossible for this office to have accomplished the results it has.

This spirit of co-operation is due in no small degree to the efforts of our Commissioner of Public Works, Mr. W. F. Sargent, who takes a deep personal interest not only in the work of the department, but in every member thereof, as well, and encourages every effort which makes for the development of the individual and greater efficiency of the department as a whole. Under his direction the department has greatly improved every phase of its work during these eight years. Mr. Sargent, himself an engineer of many years' experience, has at all times striven to put the department on a high plane of efficiency, employing sound engineering principles and good judgment in these efforts. He has surrounded himself with wide-awake young assistants of the producing type and has given them every opportunity to show their mettle and has constantly aided and encouraged them in every step which spoke for progress.

PERSONAL ITEMS

W. L. HEMPELMAN resigned his position as engineer in the service department of John Baker, Jr., Chicago, on February 1, and is now associated with the Pioneer Asphalt Company, with offices in Chicago. Mr. Hempelman was formerly engineer of bituminous pavements for the city of St. Louis.

W. E. ANDERSON has been appointed city manager of Brownsville, Tex., to succeed F. H. Williams, who recently resigned. Mr. Anderson is an engineer, formerly of Dallas, Tex.

DANIEL R. BREEN has been appointed superintendent of street repairs for Akron, Ohio. For some years he has been engaged in the municipal contracting business in that city.

RALPH M. ELDER has been appointed manager of the railroad division of the John Baker, Jr., Co., dealers in asphalt and bituminous products, with headquarters at the Chicago office of the company. He was formerly branch manager at Des Moines, Ia. He is a graduate in civil engineering from the University of Illinois, class of 1904.

D. R. LYMAN, for the past eight years chief engineer of the Department of Engineering of Louisville, Ky., has resigned. His resignation becomes effective April 1.

The STARK MOTOR TRUCK Co., Pittsburgh, Pa., are now engaged in selling Schacht motor trucks exclusively, although formerly handling contractors' heavy machinery also.

H. P. MARTIN, heretofore superintendent of streets at Dayton, Ohio, has been appointed public service director in that city and is succeeded by H. P. Ullmer.

MORRIS KNOWLES, consulting engineer, Pittsburgh, Pa., has been appointed chief engineer of the National Department of Housing. The engineering division will have supervision and co-operate in the design and construction of all utilities in the modern shipbuilding towns, including lighting, heating, water, sewerage, highways and transportation systems.

SAMUEL P. BAIRD and J. I. HUDSON have opened a consulting engineers' office at 8 E. Long St., Columbus, Ohio. They will specialize in the service of contractors, especially in the measurement of quantities and in the economical handling of construction. They will also carry on the usual engineering practice.

ROBERT L. HINCKLY has resigned as superintendent of the Rensselaer Water Co., Rensselaer, N. Y. He has accepted a position in the engineering inspection division of the Factory Insurance Association of Hartford, Conn.

CHAS. D. WEIRBACH, city engineer of Allentown, Pa., has resigned that office to become sanitary engineer for the U. S. Government under the director of health and sanitation U. S. Shipping Board, Emergency Fleet Corporation. He will serve as sanitary engineer of the Hog Island Shipyard, Philadelphia; at Bristol, Pa., and at the plant of the Submarine Boat Corportation at Newark, N. J.

CLARENCE KNOWLES has been appointed city engineer of Johnstown, N. Y.

WM. G. THOMPSON has been appointed state highway engineer of New Jersey for a term of five years by the State Highway Commission. His salary is $7,000 per annum. He succeeds Robert A. Meeker, whose term expired on April 1. Mr. Thompson was engineer of construction on the Panama Canal.

EDW. E. REED, of Trenton, N. J., has been appointed assistant engineer of the New Jersey State Highway Commission for a period of five years at an annual salary of $5,000.

SAMUEL G. HARPER has been appointed city engineer of Portsmouth, Ohio.

THOMAS B. BERGEN has been appointed city engineer of Auburn, N. Y.

JAMES E. BARLOW, formerly director of public service of Dayton, Ohio, has been appointed city manager to succeed Henry M. Wait, who has entered the Federal military service.

JOSEPH KEMPER has been appointed city engineer of Utica, N. Y.

JOHN G. MARRON is now superintendent of streets and public improvements at Titusville, Pa.

ERNEST B. BLACK, of the firm of Black & Veatch, consulting engineers, Kansas City, Mo., has received a commission as captain in the finance division of the aviation section of the U. S. Signal Corps. He will have charge of the appraisal of property at plants manufacturing airplanes.

MAYO TOLMAN, chief engineer of the West Virginia State Department of Health, has gone to Guatemala in the interest of the American Red Cross. He expects to be on this mission for a period of three months to engage in relief work made necessary by the recent earthquake. He is on leave of absence and will at the end of the period resume his work in West Virginia.

HAROLD W. HORNE has joined the engineering staff of the Miami Conservancy District, Dayton, Ohio. Since 1912 he has been division engineer in charge of the construction of reservoirs and dams for the additional water supply of Hartford, Conn., and prior to that time he was section engineer for the Board of Water Supply of the City of New York, in charge of a section of the Catskill aqueduct construction.

JOHN R. KNEEBONE, of the city of Flint, Mich., city engineer's staff, has been appointed city manager of Beaufort, S. C. He was in the service of the city of Flint since July 1, 1916, latterly as cost accountant in the city engineering department. He is the youngest city manager in the United States. At Beaufort he succeeded Harrison G. Otis, who left that city to become city manager at Auburn, Me.

G. R. SOLOMON, of the firm of Solomon-Norcross Co., consultsulting engineers, Atlanta, Ga., has been commissioned as major in the Engineer Reserve Corps and assigned to the engineering staff of the Cantonment Division. His firm has been engaged on cantonment work for the Government since last April on a number of camps in the South and West. The general practice of the firm will be continued from Atlanta as heretofore.

JOHN CHAMBERS became city engineer of Louisville, Ky., to succeed David R. Lyman, who resigned. He was at one time city engineer of Louisville and was consulting engineer for that city during the construction of the new city hospital.

HARRY F. BASCOMB has been elected city engineer of Allentown, Pa.

COMING CONVENTIONS

UNITED STATES GOOD ROADS MACHINERY EXHIBIT—Exhibit at Little Rock, Ark., April 15-19. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

UNITED STATES GOOD ROADS ASSOCIATION—Will convene in Little Rock, Ark., April 15-17. U. S. Senator J. H. Bankhead, Pres. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

BANKHEAD NATIONAL HIGHWAY ASSOCIATION—Will convene in Little Rock, Ark., April 18-19. T. S. Plowman, Pres. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

ILLINOIS SECTION AMERICAN WATER WORKS ASSOCIATION—Tenth annual meeting will be held at University of Illinois, Urbana, April 16 and 17. G. C. Habermeyer, Urbana, Ill., Acting Secretary.

TRADE NOTES

Donald F. Whittaker, former assistant advertising manager of the Federal Motor Truck Company, for whom he was also engaged in sales promotion work, later taking the position of sales manager of the Detroit Truck Company, has been appointed advertising manager of the Acason Motor Truck Company, of Detroit, for which company he will also do sales promotion work. Mr. Whittaker is a former newspaper man who has scored success in the commercial field. The Acason Company, with whom he is now connected, has for three years had its trucks, ranging from 1½ to 5 tons, on the market in Detroit and Michigan, and more than 300 trucks have made good in that territory. The Acason Company is now arranging for a large national business, and recently announced the election of J. F. Bowman as vice-president and general manager. Mr. Bowman and Mr. Whittaker, with H. A. Conlon, assistant sales manager, are busily arranging distributing agencies throughout the United States.

The new $200,000 power plant of the Pawling & Harnischfeger Company, Milwaukee, Wis., will soon be in operation. This plant is up-to-date and modern in every respect. The principal equipment consists of two 300-h.p. Badenhauser water tube boilers, equipped with preheater and superheater, Bartlett-Grover water softener, 500-k.w. 220-d.c. Allis-Chalmers generator, and a P. & H. monorail coal-handling system for unloading coal from gondola cars and depositing it in boiler room bunker, from which it spouts to boilers and is fed by Sanford-Riley stokers. The forced draft is supplied by Sturtevant fans and engine. The equipment also includes a Nordberg poppet valve engine. The reinforced concrete stack, built by the General Concrete Construction Company, has a flue 6 ft. 6 in. in diameter and is 185 ft. high.

J. P. Newell, who for several months has been assistant sales manager of the Smith Motor Truck Corporation, Chicago, has been appointed to the position of general sales manager, succeeding Berry Rockwell, who took over the general sales management last June. Mr. Newell made his reputation as district sales manager in Colorado and the Rocky Mountain district.

CATALOG REVIEWS

HY-RIB—Issued by Truscon Steel Co., Youngstown, Ohio. 5¼x7¾ in.—142 pages. Shows the use of Hy-Rib in roofs, floors, walls, sidings, partitions, ceilings and furring. Also as used in the construction of silos, tanks and conduits. Gives descriptions and properties of material. Shows many applications to a great variety of undertakings.

CONTRACTORS' EQUIPMENT—Issued by Oshkosh Manufacturing Co., Oshkosh, Wis. 8x11 in.—20 pages. Pertains especially to Oshkosh saw rigs, including "Eveready" portable saw rig and Oshkosh heavy portable rip and swing cross-cut saw rig. Also illustrates some additional equipment, including mixers, back fillers, trench pumps and building elevators.

GRAVITY CONCRETE PLANTS—Issued by Insley Manufacturing Co., Indianapolis, Ind. Catalog No. 41. 6x9 in.—64 pages. Illustrates and describes Insley gravity plant for concrete distribution. Shows all appurtenances and parts, as well as complete installations.

MOTOR TRUCKS—Issued by the Titan Truck Co., Twenty-fifth and St. Paul Ave., Milwaukee, Wis. Illustrates and describes the Titan truck in 5 and 6-ton capacities, as built for contractors and for heavy haulage service. 8½x11 in.—12 pages. Gives the reason for the production of this truck. Shows every part of the chassis in clear detail. Enumerates service features and gives specifications.

MOTOR TRUCKS—Issued by the Signal Motor Truck Co., Detroit, Mich., covering trucks of 1¼, 1¾, 2½, 4 and 5-ton capacities. Folder measures 4x9 in. Illustrates a number of trucks of the different capacities as operated by men engaged in a variety of business lines.

MOTOR TRUCKS—Complete operating and maintenance instructions for Service trucks, issued by the Service Motor Truck Co., of Wabash, Ind. 6x9 in.—64 pages.

SEWAGE DISPOSAL APPARATUS—Issued by the Sanitation Corporation, 50 Church St., New York, N. Y. Bulletin No. 4, Series G. 9x12 in.—22 pages. Illustrates and describes apparatus and equipment and complete plans for sewage disposal. It has special reference to the Riensch-Wurl sewage screen, also to grit cleaning apparatus, special valves, centrifugal pumps and reinforced concrete case pumps.

OXWELD APPARATUS—Issued by the Oxweld Acetylene Co., Newark, N. J. 6x9 in.—24 pages. Contains information about the use of the Oxweld process for cutting and welding metals. Describes apparatus and its operation in detail, with special reference to low-pressure generator, portable pressure generator, cutting and welding units, blow pipes, regulators and accessories.

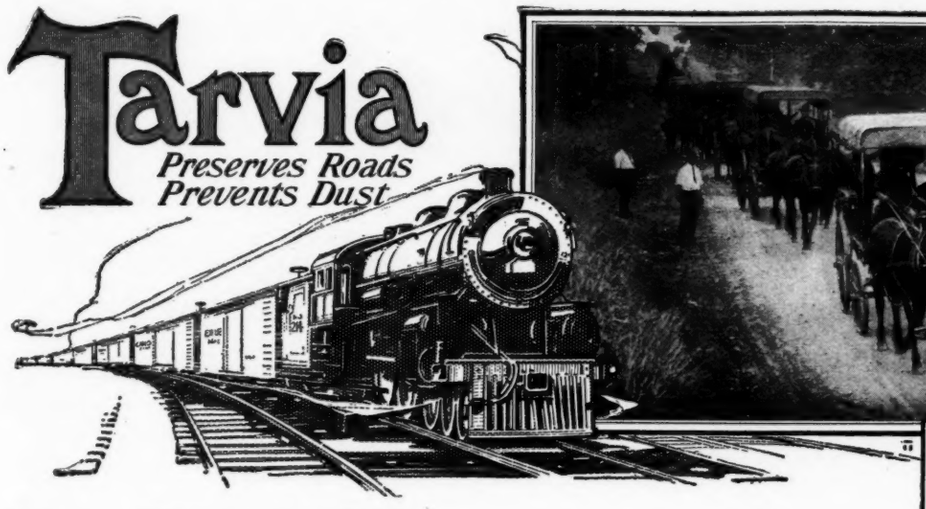
MOTOR TRUCK HOIST—Issued by Young Patent Hoist Co., 31 Twenty-fifth St., Milwaukee, Wis. Bulletin No. 12. 8x11 in.—8 pages. Prices and operation and parts of Young horizontal hydraulic hoists for motor dump trucks. This dump body equipment is for use on any make of motor truck.

REINFORCED CONCRETE PIPE—Issued by Lock Joint Pipe Co., 165 Broadway, New York. 6x9 in.—124 pages. Shows construction and design of continuous reinforced concrete pipe of the Meriweather system. Gives list of users. Many handsome illustrations showing in great detail the proper handling of this class of pipe.

SCIENTIFIC BOOKS—Issued by John Wiley & Son, Inc., 432 Fourth Ave., New York City. 5½x8¼ in.—238 pages. A complete catalog of scientific books covering engineering, industrial and technical subjects.

Tarvia

Preserves Roads
Prevents Dust



Central News

The Roads Must Help the Railroads—

PRECIOUS shipping is waiting in the harbor because cargoes are clogged on the railroads. Factories are laying off their labor and closing because they cannot get raw materials through the railroad embargoes. The whole internal commerce of the East is in a snarl, and it will be so intermittently till the end of the war and after.

Parallel with every railroad run the public highways. They are *not clogged* with traffic.

But they *are clogged* with mud or with neglect in various sections of the through-routes and the great swarm of motor-trucks traverse them slowly and with difficulty.

Clear those roads—the nation needs them!

Make your town, your county, keep up its part of the great arteries. Don't let your locality be the weak link in the chain where an impassable mile puts the whole interurban route out of commission.

It it no time to be building roads for mere beauty or comfort.

It's no time to tolerate poor roads that might be easing the overload of the railways.

Such roads call for labor and materials that are needed elsewhere.

Build and treat your roads with Tarvia.

In England and France that is just what they are doing: making their roads last longer by tarviating them on a greater scale than ever. They figure that it saves labor which is scarce and public money which is scarcer.

The Nation's plea to our local governments to refrain from public works that can wait till the end of the war does not apply to roads.

Roads were never so vital as right now. They will help us win the war.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

PHOTOS ABOVE ARE

Top—Troop movement over Tarvia-treated Government Post-Road, leading from Fort Sam Houston, Texas.
Middle—Military truck-trains need Tarvia roads for efficiency.
Bottom—Tarvia-built road. N. Main Street, Providence, R. I.

The Barrett Company

New York, Chicago, Philadelphia, Boston, St. Louis, Cleveland, Cincinnati, Pittsburgh
Detroit, Birmingham, Kansas City, Minneapolis, Nashville, Salt Lake City, Seattle, Peoria

THE BARRETT COMPANY, LIMITED: St. John, N. B., Montreal, Toronto, Winnipeg, Halifax, N. S., Sydney, N. S., Vancouver

TRADE B MARK

CONTRACT NEWS

CONTRACTS AWARDED

ROADS AND STREETS.

Ariz., Phoenix—Southwestern Contg. Co., Phoenix, award. contr. for improving Adams St.—710 sq. yds. bithu. paving at $2 per sq. yd.

Ark., McGehee—Contracts aggregating $2,788,455, awarded by the Comm. of Arkansas—Louisiana Highway & Improvement district to construct Arkansas division of Arkansas-Louisiana Highway from Brady to Louisiana line, 165 miles, via Lincoln, Drew, Desha, Chicot and Ashley Counties, as follows: Healy Construction Co., Denison, Texas, at $216,130, in Lincoln County; Metropolitan Construction Co., St. Joseph, Mo., at $170,000, in Drew County; Metropolitan Construction Co., St. Joseph, Mo., at $933,958, in Desha County; Brant Construction Co., Waterloo, Iowa, at $1,177,000, in Chico County; Burke Construction Co., Fort Smith, Ark., at $276,000 in Ashley County; road in Lincoln County of macadam, in Drew, Desha and Chicago Counties of asphalt on concrete base, in Ashley County of river gravel. Hugh Carter, State Highway Engineer, Little Rock, Ark.

Ala., Decatur—J. M. Wolf & Sons, of Decatur were awarded the contract by the Morgan County Comm. to surface the north and south State Highway with stone and slag at $31,000.

Ala., Selma—R. I. Ellis, Selma, award. contr. for bldg. 600-ft. conc. curb and 12,000 sq. yds. walks, at $10,000.

Cal., Los Angeles—W. R. Hefley, 270 Wilcox Bldg., Los Angeles, award. contr. for improvt. of New Hampshire Ave., at $1,199; Chas. D. Soteras, 802 Black Bldg., Los Angeles, contr. for grading & constuctg. oiled macad. pavement betw. Lancaster & Redman Twps.—12 miles at $223,000.

Cal., Los Angeles—E. Schelling, 4316 S. Figueroa St., city, award. contr. for improvt. of Myra St.—Santa Monica Blvd. to Hoover St., at $6,368.

Cal., Oroville—Howard Brush Co., San Francisco, award. contr. for improvt. of Oroville-Palermo Rd., abt. $5,000.

Cal., Riverside—Johnson-Shea Co., P. O. Box 906, Riverside, award. contr. for constructg. 8¾ mi. county hwy., in Couchella Valley, at $60,578.

Cal., Sacramento—Mercer, Fraser Co., of Eureka, award. contr. by State Highway Comm. for constructg. 6.02 miles of road in Humboldt County, between Eureka and Arcata, at $48,000.

Cal., Sacramento—Federal Constr. Co., Sharon Bldg., San Francisco, award. contr. for paving Plumas St., Live Oak Rd. and Bridge St., at $21,838.

Cal., Santa Barbara—J. A. Clary, San Marcos Bldg., Santa Barbara, awrd. contr. for constr. of 2 mi. conc. paving in Mesa Distr., at $24,768.

Cal., Santa Cruz—Brian Burne award. contr. for improving Ocean View Ave. from Soquel Ave. to Ocean Villa Hotel, at approximately $10,000.

Cal., Venice—Venice Contractg. Co., Venice, award. contr. for grading & constructg. 5-in. conc. pavement on Redondo Drive, at $31,869.

Fla., Key West—J. J. Quinn Co., Miami, award. contr. by Monroe Co., for bldg. Stock Isl., Key West & other roads, at $94,543.

Fla., Tampa—A. P. & L. L. Dickman award. contr. for constructg. ⅞ mi. road near Ruskin brdg.; J. J. Quinn Co., Miami, award. contr. for abt. 40 mi. rd. & brdg. work in Florida Keys, at $94,548.

Fla., Quincy—W. P. Kennedy Constr. Co., Tampa, award. contr. for 23,000 sq. yds. asph. pavement, at $65,000.

Ga., Atlanta—The Pittman Constr. Co., Rhodes Bldg., was awarded the contract for paving 12,070 sq. yds. on North Ave., with concrete at $2.14 per sq. yd.

Ill., Berwyn—H. G. Goelitz, Oak Park, for paving 26th Pl. & Union Ave., at $10,258 & $23,716, respectively.

Ill, Berwyn—H. G. Goelitz, 810 N. Blvd., Oak Park, award. contr. for paving Ridgeland Ave. & 25th St., at $32,203.

Ill., Great Lakes—The Embankment Co., Joliet, award. contr. for constr. rds. & walks at Mechanic School, at $19,740.

Ind., Goshen—Earl Sparks, Indianapolis, award. contr. for gravel rd. in Locke Twp., at $5,500.

Ind., Goshen—Elijah Cripe award. contr. for improvt. of Middlebury Rd—abt. ¾ mi. in length—for $16,728. Northern Constr. Co., city, award. contr. for improving with conc. North Riv. Rd., Concord Twp., at $5,750.

Ind., Indianapolis—Marion Co. Constr. Co., 1600 S. West St., city, award. contr. for paving 34th St. to Fort Benjamin Harrison, with asph. conc., at $152,000.

Ind., Kentland—Atkinson & Goddard were awarded the contract for constructing a section of the Potts Rd. a mile and three-quarters long, in Beaver Twp., at $8,950.

Ind., Lafayette—Harshman & Jarrell, Frankfort, award. contr. by Tippecanoe Co. for bldg. Henry Hartman Rd., at $5,738.

Ind., Laporte—County Comm. awarded road contracts as follows: Wm. D. Smith & Co., local, awrd. contr. for constr. the August Shirr Rd. in New Durham Twp., at $12,375; Jacob Ackerman, local, award. contr. for constr. the H. H. Rosenbaum Rd. in Cass Twp., at $6,440; Jacob Ackerman also award. contr. for constr. the Albert G. Rosenbaum Rd. in Hanna Twp. at $14,900.

Ind., Rushville—W. J. Neidhardt & Co., Anderson, award. contr. for conc. rd. in Rushville Twp., at $37,550.

Ind., Valparaiso—Gary Constr. Co., Gary, award. contr. by Porter Co. for bldg. gravel rd., Pleasant Twp., at $10,000.

Ia., Cresco—Frank Richardson, Maxwell, award. contr. for grading in Howard Co., at 35c per yd.—33,000 yds.

Ia., Sac City—E. W. Beeman, Omaha, Neb., award. contr. for 20,000 cu. yds. earth grading; Pheland-Chirley Co., 306 S. 24th St., Omaha, Neb., contr. for 70,000 cu. yds., at 32c per yd.

Kan., Hutchinson—Stanley-Mackey Construction Co., city, award. contr. for paving Adams St.—21,000 sq. yd. 3-in. brk., $2.10 per sq. yd.; 3,100 sq. yds. 2½-in. brk., $2.10 per sq. yd.

La., Alexandria—F. L. Constant, local, award. contr. for rd. grading and bridge and culvert. constrtg. on 16.05 mi. of rd. betw. Alexandria and Echo, at $40,000.

Md., Baltimore—Baltimore Asph. Block & Tile Co., 231 Courtland St., city, award. contr. for paving 14 streets in Annex, at $121,150.

Md., Baltimore—W. C. Evans, city, award. contr. for paving 64 alleys (conc.), at $48,000.

Mass., Belmont—Hays Bros., Waltham, award. contr. for reconstructing Belmont St., at $1.00 per sq. yd.—5,280 ft. tar macad. pace., on 3-in. crushed stone base and 2-in. bitum. conc. top.

Mass., Chelsea—Rowe Contracting Co., 1706 Commonwealth Ave., Boston, award. contr. for rds. at Naval Hospital, at $18,845.

Mass., Pittsfield—C. B. Lindholm, 51 North St., award. contr. by State Hwy. Comm., Boston, for improving W. Pittsfield & Albany Hwys., at $6,000.

KOLESCH SURVEYING INSTRUMENTS FOR SERVICE

Municipal Engineers!

Try out a KOLESCH Transit or Level on your work—at our expense. We will gladly send you an instrument to test without any obligation to purchase until it has proven its worth. KOLESCH GIVES SERVICE.

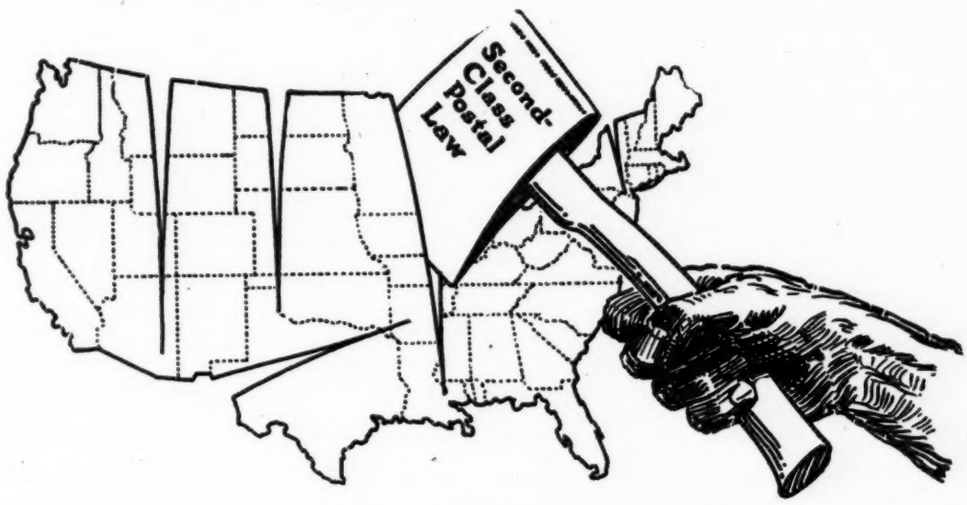
Send today for Catalog illustrating our full line of High Grade Engineers' and Draftmen's supplies.

KOLESCH & COMPANY
138 Fulton Street, New York City

The Popular Kolesch "PIONEER" TRANSIT No. 7710.

America Must Be United

In this time of unprecedented national peril and world peril, America must be strong with the strength of unity—one nation. America must be bound together, as it is to-day, not so much by the machinery of Government, as by Ideas, held in common by all and fully exchanged, so that all the people throughout the country may understand and sympathize with one another. This is what has brought this great nation together and holds it together. This result has been accomplished primarily by the Press—particularly the weekly and monthly periodicals and business papers. These periodicals have not local or sectional bias; they go to all parts of America, and serve all parts alike; their great service is in helping to bring all sections close together into one great nation, through a common understanding.



America must not be split into a half dozen sections

Weak with the ILLS and EVILS of Sectionalism

But such a disastrous result is not only possible, but probable, unless the present law pertaining to second-class postage is repealed before it goes into effect. Postal legislation was enacted in the present Revenue Bill which divides the country up into "zones" and progressively increases the average carrying charge upon newspapers and periodicals from 50 to 900 per cent.

These nation-binding publications are confronted with certain injury or destruction—which means loss to you personally, and loss to your country. It will destroy a large part of the periodicals. You will be deprived of the papers that have kept you informed on your country's problems, that have helped you in your work. Your children will lose the clean publications that have entertained and helped educate them. And eventually such magazines as do survive will cost you much more.

NO INCREASE IS NECESSARY

Last Year the Postal Department Earned a Surplus of Nearly $10,000,000

The Post Office was never intended as a tax-gathering institution. It was basically designed to give service to the people—to all the people at the same rate. The Publishers are not trying to evade taxation. They will gladly accept any rate of tax upon their profits that may be levied. Most of them have gone on record as being willing to turn over to the Government their entire net profits for the period of the war. They already pay proportionately more taxes than most businesses, but this advertisement is not designed to parade selfish troubles, but to awaken your interest in the danger of permitting the destruction or obstruction of the channels of national intelligence.

This is the time of all times when America must be a united America—one nation strong with the strength of unity.

Let Your Influence Be Used To That End

MUNICIPAL ENGINEERING

Mich., Grand Haven—Cline & Bollens, Spring Lake, award. contr. for paving on Grand Haven-Holland rd., at $36,000; Osting & Hofstein, Holland, award. contr. for improving county roads at $25,000.

Mich., Hersey—J. E. Kissinger, Ashton, award. contr. for rd. in Lincoln Twp., at abt. $30,000.

Mich., Lapeer—A. H. McMullen, Attica, award. contr. for bldg. rd. in Hadley Twp., at abt. $17,000.

Mich., Grand Rapids—Terbeek & Bronkhorst, Holland, award. contr. for constr. 2 miles of the Algoma-Plainfield town line rd. with gravel at $11,150.

Mich., Port Huron—Howland Pacing Co., Lapeer, Mich., award. contr. for constr. rd. in Fort Gratiot Twp., St. Clair Co., at $23,759.

Minn., St. Paul—M. S. Mergens, 2157 Dudley St., city, award. contr. for grading & macadamizing at $3,280; S. J. Graves & Son, Minneapolis, for claying & graveling Kohler Rd., at $3,701.

Minn., Winona—W. J. Conners, local, award. contr. for paving several streets in city at $80,000.

Mo., Cape Girardeau—J. H. Rocoso, city, award. contr. for paving in Normal—Pacific to Henderson Sts.—at $9,108.

Mo., St. Louis—Frank A. Stiers Co., local, award. contr. for brick paving on Southwest Ave., at $52,357, and Skraniks Constr. Co., local, awarded similar contract same street, at $34,948.

Mo., Webb City—M. Anthony, local, award. contr. for grading, graveling, curbs & gutter, at abt. $7,000.

Mont., Great Falls—Two Miracle Conc. Co., 437 Ford Bldg., city, award. contr. for laying walks, crossing & curbing during 1918, at $7,619.

N. J., Atlantic City—Headley-Weathley Co., Guarantee Trust Bldg., award. contr. for blvd. entrance at Virginia & Adriata Ave., to Indian Ave., Venice Park, at $100,000.

N. J., Jersey City—Clinton Contg. Co., 306 Charles St., W. Hoboken, award. contr. for paving Woodlawn Ave.—bitum. conc.—at $120,000.

N. J., Newark—Newark Paving Co., city, award. contr. for improving Concord Ave., at $119,800.

N. Y., New York—Hastings Pavement Co., 25 Broad St., city, award. contr. for constr. drway. on Pier 26, at $6,360.

N. Y., Watertown—Burns Bros. & Haley, Bank Bldg., award. contr. for paving Pearl St., at $32,950.

N. C., Charlotte—Porter & Boyd, local, award. contr. for constr. abt. 3 mi. of concrete rd. at $500,000.

O., Belleville—Hoeffken Bros. Constr. Co., city, award. contr. for earth grading on New Athens-Freeburg Rd., at $26,075.

O., Cincinnati—Kirchner Constr. Co., local, award. contr. for improving street at $5,591; Henkle & Sullivan, local, award. contr. for improving Pike St., at $11,694.

Ohio, Cincinnati—Gradison Construction Co., 216 E. Front St., city, award. contr. for construct'g. Harrison and New Haven Rd., No. 36, at $13,417.

Ohio, Mansfield—F. Gandert & Sons, Mansfield, awarded contract by Richland County for grading and paving Bowman Road a distance of 3,650 ft. with reinforced concrete pavement, 6 ft. wide and 7 in thick at $19,437.

Ohio, Toledo—Harris & Tansey will probably be awarded contract for repaving of Adams St., with creosoted wood blk., on concrete foundation, at $71,900.

Ohio, Youngstown—L. W. Russell, W. Austintown, award. contr. for grading rd. abt. 3½-mi. long from N. Lima to Columbiana Co. line, at $22,851.

Ohio, Youngstown—Kelley & Mayer Co., local, award. contr. for paving three streets at $57,794.

Okla., Sapulpa—Nolan Paving Co., local, award. contr. for paving in Dt. No. 37 at $38,430.

Ore., Salem—About 21 miles Pacific Hwy.,—here to Aurora—asph. conc. will be constructed by day labor. Est. cost $359,-546.

Pa., Butler—Summit Constr. Co., Akron, O., award. contr. for 1.6-miles rein.-conc. rd., Butler Co., Adams Twp., at $32,320; also for 3.69 mi. reinforced conc. rd., Slippery Rock Twp., at $123,995.

Pa., Harrisburg—Austin & Matthews, city, award. contr. by State Hwy. Com. for improvt. of approx. 4.5 miles in Allegheny Co., at $158,213; Vicenzo Di Giorno, city, award. contr. for construction of approx. 7 miles in Lycoming Co., at $226,634.

Pa., Harrisburg—W. C. Evans, Ambler, award. contract by State Hwy. Comm. to construct 7.45 mile road of bituminous macadam on telford base from north line Somerset township to Jennerton Borough at $233,838; B. L. McKillip, Hollidays Burg, award. contract to construct road in Lawrence township, Clearfield county, 4,700 ft. long at $38,928.

R. I., Woonsocket—Simpson Bros., award. contr. for paving with Hassam during 1918, at $543 sq. yd. for laying granite blks. on conc. fdn., includ'g. excav., $1.40 per lin. ft. furnishing and setting new curbs, etc.

Tenn., Hadley's Bend—Mason & Hanger, 504 Trust Bldg., Lexington, Ky.,- award. contract by E. I. duPont de Nemours & Co., to build concrete roads as part of new $60,000,000 government explosive plant.

Tenn., Columbia—C. J. Akin, Engr., award. contr. to Thompson, Graham Co., Nashville, to construct 26,000 yds. asphaltic conc. paving at about $30,000.

Tex., Corsicana—McElwrath & Rogers, city, award. contr. to construct rds, $200,-000 available.

Tex., Crosbyton—S. Webb, Belleview, award. contr. by Crosby Co., for bldg. 7.16 miles on East Plains Rd.; 14.36 mi. on Mt. Blanco Rd., and 1.14 miles on West Fort of Mt. Blanco Rd., at $46,026.

Texas, El Paso—El Paso Bithu. Co. award. contr. for paving of Ysleta Road, at $186,000.

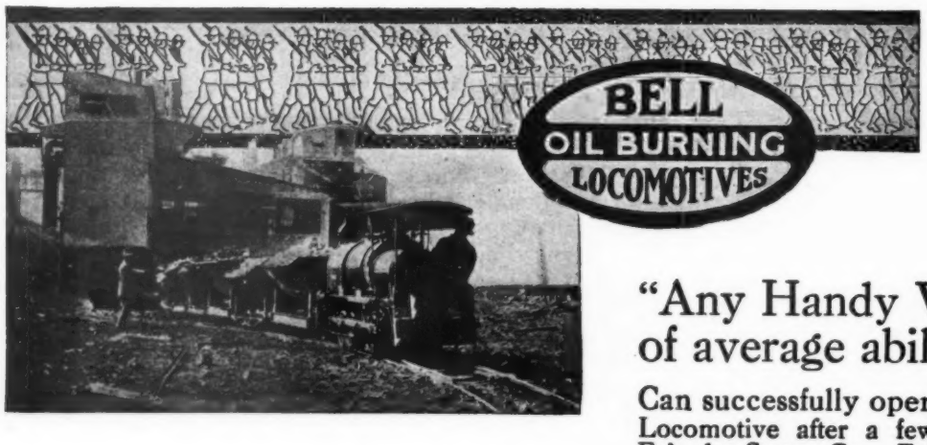
Tex., Galveston—J. C. Kelso, Galveston, award. contr. to pave Twenty-ninth St., Avenue B to Avenue D., with vit. brk. on conc. base, at $9,581.

Tex., Oakville—Bingham Bros., Rogers, Tex., award. contr. for rd. constr. at $90,000.

Tex., El Paso.—El Paso Bitulithic Co., local, award. contr. by city to pave Arizona St. between Laurel and Grand View streets and Laurel street between Cotton and Grand View streets.

Tex., Wichita Falls—Womack Bros., Sherman, Tex., award. contr. by Wichita Co. Conrs. for 108 mi. county rds. to be improved this year, at $9,000 a mile.

Wash., Bellingham—Kaiser Paving Co., Everett, Wash., award. contr. for paving Allen-Avon Rd., at $90,000 to $97,000; R. M. Hardy, Seattle, award. contr. for paving Olympia-Marsh-Riverside rd., at $50,180.



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Can successfully operate and care for a **Bell** Locomotive after a few days practice," states the Fajardo Sugar Co., Fajardo, Porto Rico. "Our **Bell** does five times the work originally accomplished by other methods.

"Center of gravity is low and the frame is flexible. That's why we are able to get good speed on rough tracks. Repairs are very little and cost of operation low."

Bell Locomotives supplant man and team power—and both are scarce and expensive. The **Bell** is the only reliable locomotive that operates on any kind of liquid fuel.

Bell Locomotives (narrower, lower and shorter) take up less room and stick to the track when going at high speeds. You will need **Bells** on your contract work this year. Send for illustrated particulars now.

BELL LOCOMOTIVE WORKS, Inc.

30 Church Street. **(Founded 1908)** **NEW YORK CITY.**

ADJUSTABLE

For Thirty-nine Different Sized Openings and will build any length culvert.

THE ONE MAN COLLAPSIBLE CULVERT FORM

Will Cut Culvert Costs Tremendously

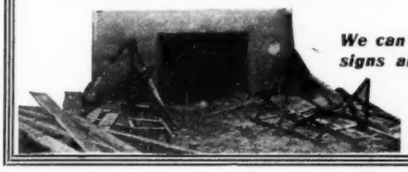
Supplied in Sections each 4 feet long

This form makes possible the Permanent Concrete Culvert at Small Cost.

Don't Specify or Build Culverts of any type until you have read our Booklet—sent on request.

Permanent drainage at reasonable cost is what you want. Our booklet shows you how to build Culverts from the smallest to the largest of **Concrete** at a surprising saving in cost over other methods. Metal Pipe, Vitrified Tile and Cement Tile are all compared and **figures given.** Write for the booklet. Sent without charge on request.

Storms Manufacturing Co. 52 West Van Buren St. CHICAGO, ILL.



We can also supply special designs and sizes of collapsible forms for storm sewers (leased on percentage basis).

Careful!

Cutter Traffic Signal Posts are constant, persistent reminders that "all vehicles shall keep to the right and as near the right hand curb as possible."

CUTTER
Traffic Signal Posts

are "islands of safety" for pedestrians. The globe (ruby in color) is made of translucent glassware, combining high transmission qualities with good diffusion! It can be ***distinctly*** seen at great distances—day or night.

GEORGE CUTTER COMPANY
SOUTH BEND, IND.

Chicago Detroit New York
Los Angeles San Francisco Seattle

"We recently received a call from the sales manager of a large motor truck concern which we understand was the suggestion of MUNICIPAL ENGINEERING. We reached an agreement with this concern whereby we are to represent their dump trucks in Chicago and vicinity. The acquiring of this valuable agency will enlarge our field of effort, and you may rest assured that we appreciate the good things you have said—it goes without saying that you said something, and if I can ever be of service to you—come on! With the best of good wishes."

Municipal Engineering

"Pioneer" Expansion Joints

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Wash., Ritzville—Henry Rosenoff, Sr., city, award. contr. for construction of 8¾ miles county hwy., at $54,000.

Wash, Seattle—McGuire Bros., American Bank Bldg., city, award. contr. for grading Northlake Ave., et al., at $70,957.

Wash., Seattle—R. M. Hardy, 2535 34th Ave., so., Seattle, award. contr. for paving Olympia-Marsh-Riverside Rd., in Skagit county, with concrete at $50,180.

Wash., Seattle—Clifton-Applegate Co., Spokane, award. contr. by Whitman Co. for grading 23 miles of Steptoe-Ewan Rd., at $212,300.

Wash., Spokane—Standard Asph. Co., 517 Lincoln St., N., award. contr. for grading and paving with 6-in. single-course conc., also bldg. sidewalks on Post St., at $31,013.

Wash., Tacoma—R. M. Hardy, 2535 34th Ave., S., Seattle, award. contr. by Pierce Co. Comrs. for 1¾-miles 1-course conc. paving, at $30,300.

Wash., Wenatchee—Clifton, Applegate & Toole, Spokane, award. contr. for paving 1 mi. hwy., at $23,948.

Wash., Yakima—Thos. Dingle, award. contr. for bldg. 33,850 ft. ofroad N. E. of Whiteswan, at $6,094.

Wis., Portage—General Contracting Co., Minneapolis, award. contr. for curbing, guttering and 9,200 sq. yds. bithu. paving, at abt. $23,000.

Wis., Stevens Point—Murphy Constr. Co., Manitowoc, award. contr. for paving abt. 2 miles, $38,000.

Wis., Superior—John Differ, 1610 20th St., local, award. contr. for paving Main St. and Lamborn Ave., at $41,023.

Wis., Tomah—Western Constr. Co., La Crosse, award. contr. for rein-conc. paving on abt. 12 streets, at $25,000.

W. Va., Huntington—Amos Trainer, city, contr. for 4,600 yds. paving at $14,000.

W. Va., Kingwood—Spindler, Kingwood, local, award. contr. by Preston County, for building asphalt road in Kingwood district at $160,000, and concrete road in Portland Dist., at $250,000.

W. Va., Middlebourne—Tyler County will pave and curb (by day labor) 1 mi. brk. road 12 ft. wide, metal conc. fdn., about $25,650.

SEWERAGE AND SEWAGE TREATMENT.

Ark., Texarkana—Allen Winham, city, award. contr. for constr. of sewage disposal plant, at $188,257.

Ark., Texarkana—Ralph Taylor, city, award. contr. to construct joint sewage-disposal plant, at $128,937.

Cal., Calexico—Bush Constr. Co., local, has been sub-let contr. by G. R. Daley, local, for constr. of san. sewers, at abt. $18,000.

Cal., Long Beach—J. Wost, 2152 Reservoir St., Los Angeles, award. contr. for bldg. 27,500 lin. ft. cem. pipe sewers, etc., in Sew. Dist. No. 7, at $31,487.

Ida., Rupert—B. M. Barsden & Co., Butte, award. contr. for sewer constr. in Dist No. 1, at $82,000.

Ill., Rockford—A. E. Rutledge, G. W. Mulholland and C. E. Tole Co., all of Rockford, awarded sewer contracts, at $4,766, $4,234, and $1,516, respectively.

Ia., Marcus—Comstock & Hanson, local, award. contr. for construct'g. 3,640 ft. 10-in. and 18,626 ft. 8-in. clay sewers, at $23,837.

Kans., Belleville—E. D. Reed, Clay Center, award. contr. for bldg. lateral and intersect'g. sewers; outfall sewer and disp. plant to Intermtn. Brdg. to Constr. Co., Tecumseh, Neb., abt. $89,975.

Kans., Marquette—C. L. Burt, Hutchinson, award. contr. for bldg. sewerage sys., at $14,202.

Mass., Quincy—City will bldg., by day labor, main sewer to drain Wollaston Park Annex, 18-in. Akron vit. pipe in conc. earth trenching, etc. P. F. O'Brien, City Engr.

Minn., Brainerd—Pastoret Constr. Co., 511 Lyceum Bldg., Duluth, award. contr. for construct'g. sewer lateral, at $2,984.

Minn., Winona—Wm. Danforth, 707 Germania Life Bldg., St. Paul, award. contr. for storm and san. sewers, at $10,000.

Minn., Winona—Peter Strob, Winona, award. contr. to construct sewers at $12,980. Geo. W. Hofman, City Clk.

Mo., Kansas City—W. C. Mullins, award. contr. for bldg. second sec. of Town Fork sewer in southeastern part of city, at $94,430.

Mont., Poplar—G. Nordquist, city, award. contr. for bldg. sewerage sys., at $39,298.

N. J., Newark—Merrit & Chapman Derrick & Wreck Co., N. Y. City, award. contract for completing Sec. 1, of Passaic Valley trunk sewer. Work includes outfall pipes at New York Bay. Est. cost, $300,000.

N. J., Phillipsburg—Pasco Constr. Co., Easton, Pa., award. contr. for construct'g. parts 1 and 2 of sewerage system, at $21,425 and $8,130 respectively. L. F. Kratz & Son, Allentown, award. contr. for parts 3 and 5 at $24,064.

S. D., Watertown—Watertown Tile & Constr. Co., local, award. contr. for drainage propositions in Henry, at $4,250.

Wash., Seattle—Superior Constr. Co., local, award. contr. for constr. of sewers in 22nd Ave., S. W., at abt. $69,824.

Wis., Kenosha—E. H. Prange, Grand Rapids, award. contr. for install'g. trunk sewers, at $80,733.

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The contractor has a short memory. Are you willing to risk his forgetfulness—or even to invite it? Figure it out in dollars and cents. Can you afford it?

WATER SUPPLY AND PURIFICATION.

Cal., Napa—D. O. Church, 500 Hampshire St., San Francisco, award. contr. for laying 14 mi. of pipe for water sys. to supply State Hosp., Veterans' Home, etc., at abt. $55,000.

Cal., Pasadena—Byron, Jackson Iron Wks., 6th and Carlton Sts., Berkeley, award. contr. for deep well pumps, at $6,300.

Cal., Santa Barbara—E. R. Hunt, award. contr. for brushing out 400 acres comprising storage basin of Gibraltar dam, at $12,000.

Cal., Tracy—O'Brien Bros., 240 Montgomery St., San Francisco, award. contr. for bldg. 1650 ft. rein.-conc. discharge pipe at $18,627.

Colo., Pueblo—Leslie, Linville & Meek, 112 W. 11th St., award. contr. for furnishing material and bldg. storage basin, at $24,494.

Ga., Savannah—Layne & Bowler, Exchange Bldg., Memphis, award. contr. for furnish'g. and install'g. elec.-driven water pump for Gwinnett St. water sta. at $5,800.

Ia., Marshalltown—Murry Iron Wks., Central Ave., and Wash. St., Burlington, award. contr. for new 16x72 in. boilers for waterworks, at $8,265.

Ia., Oelwein—City will build by day labor filter beds., abt. $6,000. G. H. Bishop, City Engr.

Kans., Kansas City—Conner Constr. Co., 1032 Caswell Ave., city, award. contract for reservoir at 13th and Lawrence, at $74,500.

Mass., Boston—Jas. Barretta, local, award. contr. for furnishing and laying 8 and 12-in. steel pipe; also laying c. i. pipe in So. Boston, at $4,018.

Mass., Fall River—P. L. Courchaine, city, award. contr. for bldg. pumping sta., at $9,138.

Mont., Geraldine—Miracle Concrete Corp., Great Falls, award. contr. for development of water supply distributing sys., new extensions, etc., at $14,400.

Neb., Fremont.—Wright Electric Constr. Co., city, award. contr. for install'g. water, lighting plant, etc., at $10,989.

Neb., Lincoln—J. L. Muller, Lincoln, award. contr. for construct'g. pumping station at $14,249.

N. J., Hoboken—O'Neill & Cutley, local, award. contr. for construc. of an auxiliary submarine water main under Hackensack and Passaic Rivers, at $438,545.

N. J., Jersey City—O'Neal & Cutley, 62 Van Reipen Ave., award. contr. for water main under Hackensack and Passaic Rivers.

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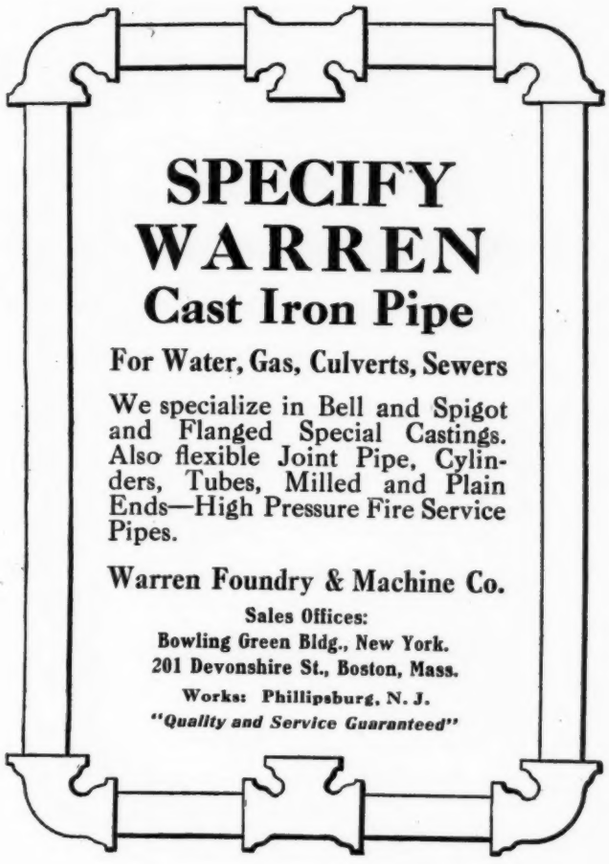

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N. J., **Lodi**—Contracts awarded for distribution of system of water works as follows: Section 1, 11,775 ft. 4 to 8 in. cast iron pipe, hydrants, etc., to J. Fox & Co., 253 Broadway, New York, at $13,647; Section 1, laying pipe, setting hydrants, valves, etc., to Di Napoi & Allen.

N. Y., **Brooklyn**—E. G. Vail, Jr., 145 Bay 22nd St., Brooklyn, award. contr. for protecting water pipe, Sec. Base No. 6, at $2,350.

N. Y., **Phoenix**—Chas. R. Lewis, Ilion, award. contr. for bldg. and equipping pumping sta. in connect. with water plant, at $6,496.

O., **Dayton**—City will extend and improve water sys., by day labor, abt. $25,000. F. O. Eichelberger, City Engr.

Ohio, Lorain—Pittsburg Filter Mfg. Co., award. contr. for installation of strainer sys., at local water filtration plant, at $7,300.

Ore., Coquille—Astlind & Payne, city, award. contr. for constr. of conc. viaduct, Summit Co., at $9,669.

Pa., Erie—Cantrell Co., 30th and Walnut Sts., Philadelphia, award. contr. for Mill Creek Improvt., on 10 per cent basis, abt. $975,000.

S. D., Lake Andes—Jas. J. Orr, Yankton, award. contr. for sewer constr., at $24,500.

Tex., Henrietta—J. N. Gurley, city, award. contr. to bldg. 184 ft. rein. conc. dam across Little Wichita River, to furnish water supply, at $5,600.

Va., Norfolk—R. D. Wood & Co., 400 Chestnut St., Philadelphia, award. contract for furnishing 2 6,000,000-gal. elec.-driven centrif, pumps to be installed in pumping station, at $5,500.

Wis., Hartford—Kissel Bros., Hartford, award. contr. for pump for waterworks system, at $5,029.

Wash., Seattle—Thos. Scalzo, award. contr. for laying water mains on 41st Ave., S. W., at $10,647.

Wash., Seattle—Morris & Miller, 3053 16th Ave., W., for furnishing matl. and installation of water pipe line to serve Water Dist. No. 4, at $3,519.

Wash., Walla Walla—Concrete Pipe Wks., Bd. Trade Bldg., Portland, Ore., award. contr. for bldg. concrete pipe line for water sys., at $15,470.

BRIDGES AND BUILDINGS.

Ala., Dothan—F. M. Dobson, Montgomery, Ala., award. contr. by Houston Co. Comrs., to constr. conc. brdgs., culvts. and headwalls on State Rd. No. 17, at $14,620.

Ala., Montgomery—F. M. Dobson, city, award. contr. for 4 bridges in Houston Co., at $14,628.

Ark., Bentonville—Missouri Valley Brdg. Co., award. contr. for construction of bridge across Illinois River at Gamble's Ford, at $6,000.

Ark., Little Rock—Missouri Valley Brdg. & Iron Co., Leavenworth, award. contr. to construct viaduct at 11th St. and Summit Ave., at $5,900.

Cal., El Centro—W. M. Ledbetter, Pacif. Elec. Bldg., Los Angeles, award. contr. for 382-ft. pile timber brdg. over San Felipe River, at $7,863.

Cal., La Grange—Burt T. Owsley, 180 Jessie St., San Francisco, award. contract for rein.-conc. brdg. over Snake Ravine, at $12,843; also 5 siphons and one culvert, at $2,497.

Ill., Dundee—Ottendorf Constr. Co., Palatine, Ill., award. contr. for constr. of Main St. rein.-conc. bridge, at $42,794.

Ill., Springfield—S. P. Kershaw, Kankakee, award. contr. for bldg. Cooper Brdg., Bourbonnais Twp., Kankakee Co., at $2,275; Herrick Constr. Co., city, award. contr. for Bowman Brdg., Macoupin Co., at $3,225; for Chism, Clondike, Duckles No. 1 and Reddington brdgs., Macoupin Co., at $6,211; for Jones & Peak Brdgs., Brighton Twp., at $1,348; for Bloome, Boston, Chappell and Demming brdgs., Nilwood Twp., $3,614.

Ind., Anderson—Elkhart Brdg. Co., local, award. contr. for bldg. brdg. in Elwood, at $6,302; E. St. Louis Brdg. Co., contr. for Superstruc. of brdg., in Alexandria, at $6,721.

Ind., Indianapolis—American Constr. Co., 103 N. Delaware St., award. contr. for Senate Ave. brdg., at $122,516.

Ia., Burlington — Clinton Brdg. Wks., award. contr. for 1 50-ft. pony truss with 5,890 lb. bars. at $1,500.

Ia., Cedar Rapids—Klaufer Mfg. Co., Dubuque, award. contr. by Linn Co., for bldg. corrug. iron culvts., including 700 ft. 12-in., at 77 cents per ft.; 1,500 ft. 15-in. pipe, at $1.22 per ft., and 400 ft. 18-in. at $1.45 per ft.

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The Nation will thus be unified and the business situation clarified; all the necessary taxes can be paid by the necessary bonds sold.

Use Your Influence

N. D., Hillsboro—Hardine & Anderson, award. contr. for bldg. steel, wooden and conc. bridges during 1918, at abt. $30,000.

Ia., Des Moines—N. M. Stark, Des Moines, award. contr. for rein-conc. deck girder brdg. No. 634 over Beaver Crk., at $14,400.

Iowa, Elkader—Rodeist Boles, Strawberry Point, awarded contract for constructing 2 140-ft. high Trussed Steel bridges on concrete abutments, 1 20-ft. concrete slab bridge, 2 reinforced concrete culverts, at $26,805.

Iowa, Sac City—Iowa Brdg. Co., 712 Hubbell Bldg., Des Moines, award. contract for 100-ft. arch. 45 and 85 ft. pony truss and 5 I-beam span brdgs., at $38,122; F. M. Stewart, Ames, award. contr. for box culvt., and 2 I-beam span brdgs., at $7,268; 2 box culvts., to J. Waddicor, Schaller, at $2,385.

La., New Orleans—Crescent City Constr. Co., award. contr. for constr. of conc. drain. culvert at Broadway and S. Claiborne Ave., at $10,590.

Minn., Bemidji—Illinois Steel Brdg. Co., 552 Gilfillan Blk., St. Paul, award. contr. for 3 60-ft. spans. brdg. across Miss. River, in Brook Lake, at $13,480.

Minn., Chisholm—Osmond Abbey, city award. contr. for Longyear Lake brdg., at $50,000.

Minn., Morris—Foley, Young & Peabody, 418 Merchant's Natl. Bank, St. Paul, for 400 ft. span, at $17,685.

Mont., Shelby—J. F. Harrington, Missoula, Mont., award. contr. for constructg. 220-ft. comb. wood brdg. on conc. pier, at $8,767.

Neb., McCook—Ward & Weighton, 516 Davidson Bldg., award. contr. for bldg rein.-conc. brdg., in Red Willow Co., over Republican River, at $23,300.

Neb., No. Platte—Thos. Gass, Elm Creek, Neb., awarded contract for construction of reinforced concrete bridge consisting of 10 50-ft. arches with concrete piers and abutments, at $38,245.

Neb., Pender—Standard Brdg. Co., 1302 City Natl. Bank, Omaha, award. contract for constr. of 5 bridges, at $9,500.

Neb., St. Paul—Thomas Goss, Elm Creek, awarded contract to build State Aid bridge across Platte River in Lincoln county, at about $38,000.

N. J., Freehold—Louis J. Sieling, Rd. Bank, award. contr. for rebldg. brdg. connect'g. Highlands and Highland Beach, at $38,700.

N. J., Newark—Bethlehem Steel Brdg. Corp., local, award, contr. for reconstruct'g. part of Lincoln Hwy. Brdg. over Passaic River, at $71,400.

N. M., Farmington—Monarch Engineering Co., Falls City, Neb., award. contr. for construct'g. steel brdg., at $25,000.

Ohio, Youngstown—C. M. Needd Constr. Co., Oliver Bldg., Pittsburgh, Pa., award. contr. for Cedar Street Bridge, at $46,000.

Ore., Portland—Bridge Co., awarded contract for construction of bridges across the Umpqua River in Douglas county, at $18,730, and contract for bridge across Hood River in Hood River county, awarded to Banfield and Parker, at $35,914.

Wash., Seattle—H. C. Malot, 6576 17th Ave., N. E., city, award. contr. for 2 conc. spans for Steptoe-Ewan Hwy., near Colfax, at $13,840.

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W. Va., Rowney—Enterprise Constr. Co., Elkins, W. Va., award. contr. for constructing conc. arch brdg. across south branch of Potomac River, at $15,485.

W. Va., W. Hamlin—Oregonia Brdg. Co., Lebanon, Ohio, award. contr. by Lincoln Co. court, for steel bridge across Guyandotte River, at $15,503 for superstruc.; $10 per cu. yd. for sub-structure.

Wis., Superior—Wm. F. Hill, 17 Wisconsin Bldg., city, award. contr. for conc. dock, at $40,000.

PROSPECTIVE WORK

ROADS AND STREETS.

Ariz., Douglas—$1,000,000 bonds voted by Cochise Co., for constr. of Co. Hwy. system. Work on first sec. will consist of conc. hwy. from here to Bisbee—27 mi. Approx. cost, $618,000.

Ariz., Cochise Co.—$1,000,000 bond issue approved by county for constr. of county hwy. system.

Ark., Fayetteville—President Biddle of the Frisco R. R., has signed petition for rd. dist., north and south through Washington Co., to connect with hwy. to be built from Van Buren to northern line of Crawford Co. Rd., will be 44 mi. long in this county and cost approx. $165,000. Pres. Biddle has also signed on behalf of the railway for Crawford Co. end of rd. Crawford Co. assessment of railroad will be $618,313. He will also sign in favor of proposed north and south highway in Benton Co.

Ark., Lake City—Plans being prepared by Klyce & Kackley, 505 4th and 1st Ntl. Bank Bldg., Nashville, for Craighead Co. Comrs., for bldg. 25 mi. broken stone rd.

Ark., Little Rock—Plans being completed by State Hwy. Dept., for constr. of Little Rock-Batesville Hwy. Road to be 140 mi. Approx. cost, $820,000. Plans have been sent out by Dept. for 37 mi. rd. in Clark Co. Approx. cost, $348,925.

Ark., Little Rock—State Hwy. Comm. has sent out plans for 18-mi. rd. in Jackson Co. Est. cost, $105,213; also plans for a system of gravel hwys. in Little River Co. Approx. cost, $272,723. These rds. will connect Ashdown, Foreman, Mill Ferry and Lewis Ferry—70 miles.

Ark., Newark—Plans and specifications received here for No. Arkansas road district comprising 7 counties and involving 144 miles of road to be built at cost of about $345,000.

Ark., Piggott—Plans completed for abt. 33 miles of rd. in Clay Co., by State Hwy. Comm. Est. cost, $151,318. R. E. Lewis, Co. Judge.

Cal., Porterville—City will pave streets in all directions from main bus. district to connect with county units of hwys. now under construc., Woodville, Visalia, Worth and Richgrove, 5-in. conc. base with 1½-in. Warrenite surface has been adopted as principal feature of specifications.

Cal., San Francisco—$1,250,000 bond issue for county roads will be voted on at August primaries.

Cal., Santa Ana.—City planning to pave Bristol St., involv'g. abt. 78,000 sq. ft. concrete. C. C. Bonebrake. City Engr. Orange County has had plans prep. for road betw. Newport and Laguna Beach. About $30,000.

Conn., Bridgeport—Bd. of Apportionment will add several thousand dollars to budget for street and sidewalk improvts., which will make total amt. to be expended, $114,805.

Fla., Arcadia—DeSoto County, Dist. No. 4, has voted $330,000 in bonds to construct 38 miles of road of brick, asphalt, concrete or other material.

Fla., Jacksonville—Schedule for street paving submitted by Engineer Edwards has been approved by Commission. Est. cost of work, $122,384.

Fla., St. Petersburg—State Hwy. Comm. has selected rd. from Brooksville to Apopka, south to Tarpon Springs, and Ozono, with branches to St. Petersburg and Tampa, as state aid road.

Del., Wilmington—State Hwy. Comm. expects to begin work of improving highways abt. May 1st. Phila. pike and Penny Hill will be among first projects undertaken. Bids may also be asked for stretches in Kent and Sussex Cos.

Ga., Atlanta—Citizens on So. Pryor St., are urgently requesting paving of said street from Western and Atlantic R. R. to Gannett St. This will complete trunk line artery for traffic extending from Camp Gordon on north to Lakewood Park;

HIGHWAY TRANSPORT COMMITTEE

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Roy D. Chapin, Chairman; George H. Pride, L. W. Page, H. G. Shirley, A. C. Hargreaves, Secretary. The primary duties of this committee are to facilitate the transport of Government war trucks from the factory to the coast by road and under their own power. These trucks are loaded with Government supplies and operated by men who thus gain experience in road transport which will be of immense value "somewhere in France" later on.

Part of the program includes the keeping of main roads in good condition irrespective of weather conditions, and the full co-operation of the various State Highway Engineers has been requested and is being enthusiastically taken up by these officials.

It is probable that this committee will take up the matter of road transport of freight from city to city, using trucks suited to the capacity of the individual load. Inquiries should be addressed to Mr. Hargreaves.

widening of Luckie St., Bartow to North Ave., is also being requested.

Ga., Augusta—Nisbet Wingfield, Comr. Pub. Wks. working on specifs. for 8-mile loop of paving. Bids soon to be asked.

Ga., Augusta—Bids soon to be asked for paving four streets, about 1 mi. Approx. cost, $300,000. Wm. B. Bell, Chrmn., City Council.

Ida., Lewiston—State Hwy. Dept., planning to build first portion Lewis and Clark Hwy., Kooksie to Missoula. State and Fed. aid, $40,000. Contr. soon to be let for bldg. Grangeville-Whitebird link of north and south state hwy. About $220,000.

Ill., Chicago—Movement launched, west of Chicago, for paving continuous hwy. across Iowa, to connect with conc. paved Lincoln hwy. across Illinois. Clinton Commercial Club has taken initiative and is asking aid of every town along proposed route, with more than 3,000 population.

Ill., Freeport—City contemplates asph.-conc. paving on proportions of Lincoln Ave., Locust and Galena Sts. Est. cost, $34,566.

Ill., Glencoe—About 44,000 sq. yds. of paving being considered. Est. cost, $225,000. Windes & Marsh, Engrs., Winnetka.

Ind., Fort Wayne—Appropriation of $75,000 for improvement of Lincoln Highway in Allen County ratified by County Council. This money, with $73,000 furnished by Government, will improve Highway from Eastern State line to point 8 miles west.

Ind., Goshen—County Council appropriation $60,000 for paving of Lincoln Hwy. in Benton Twp. State Hwy. will give like amt. There is now available $120,000 for improvt. of this road, which sum may be increased to $140,000. Total length to be improved is 7¾ miles.

Ind., Mich. City—La Porte Co. will receive fed. aid. to amt. of $57,500 for improving Lincoln Hwy. Bonds will be issued by County in sum of $57,000.

Ind., South Bend—Council passed resolution for resurfacing Jefferson Blvd. for 1,150 ft. with sheet asphalt, brick, bitulithic or creosoted block at estimated cost of $31,000. Bids will be taken April 2nd, by City Engineer, Anderson.

Ia., Cedar Falls—Plans under way for construction of rd. betw. here and Waterloo. Federal Government will give $45,000; County, $100,000 and citizens equal amount.

Ia., Sioux City—City Engr., T. H. Johnson, preparing plans for repaving one street and paving eight streets; also several alleys. Est. cost, $40,000, $37,500 and $10,000 respectively.

Kans., Erie—About 45 miles gravel road will be built by County. Est. cost, $220,000. W. J. King, Engr., preparing plans.

Kans., Junction City—A petition signed by every property owner along the Golden Belt Road from this city to the Dickinson County line sent to County Commissioners, asking for a concrete road and the road will be built at once.

Kans., Topeka—State Hwy. Comm. considers following roads of first importance for 1918 construction: Conc. rd.—Topeka to Kansas City, Kans. and Leavenworth by way of Tonganoxie; also macad. rd. in Baron Co., and gravel rd. in Labette Co.

Ky., Louisville—Improvt. of streets to begin in three weeks. First St. to be given attention will be Broadway—First to Campbell Sts. Granite paving will be used betw. and along railroad tracks and will cost $30,000 to $40,000. Long list of streets in need of improv'g. being prep. by Engr. Lyn.

Md., Annapolis—State Senator Metzerott of Prince Georges County introduced bill in State Legislature asking immediate construction of Natl. Defense highways between Annapolis and Washington, D. C.

Md., Baltimore—Bd. of Estimates will expend $40,000 for improvts. in Mt. Vernon Sq. Plans by Thos. Hastings.

Mass., Boston—State Highway Comm. plans to build 1.82 mi. of Cotuit Rd.; 18 ft. wide in Sandwich—including grading and surfacing with 4-in. sand asph.; 6.9 mi. rd., 18 ft. wide—Athol to Petershaw—asph.-slab macad.; 2.63 mi. Gorton Rd., Littleton, 19 ft. wide, bitum. conc. with gravel surface, and others. A. W. Dean, State Hwy. Engr.

Mass., Cambridge—City having plans prepared for widening Prospect St.—Central Sq. to Somerville line, 3,650 ft. long, 50 to 70 ft. wide. Est. cost, $93,400. L. M. Hastings, City Engr.

Mass. Towns—Various Mass. towns have voted money for Highway and Bridge improvements as follows: Hingham, $18,250; Wareham, $16,175; Greenfield, $40,000; Marion, $15,000; Andover, $25,000; Weymouth, $27,000; Concord, $24,500; Winchester, $51,000; Manchester, $23,000.

Mich., Battle Creek—Plans under way to construct Upton Ave. (or parallel road). Est. cost, $70,000—$50,000 on hand.

Mich, Grand Rapids—The 310th Engineers at Battle Creek (Camp Custer) recommended paved loop to take care of heavy traffic from Camp to Battle Crk. Plans call for hwy. south from Camp to end of Upton Ave. paving. Est. cost, $70,000.

Mich., Grand Rapids—Bids soon to be asked for gravel surfacing Kent-Iona trunk line rd.—13½ mi. long and 16 ft. wide.

Mich, Marquette—Fifty-mile hwy. through Baraga County will be built this summer.

Minn., Minneapolis—Projects for approx. $2,000,000 worth of rd. bldg. in state have been prepared. Work has been launched in four counties. Fed. aid to be asked on 260 miles which will cost abt. $750,000; also a large number of additional projects entailing expenditure of abt. $1,250,000.

Minn., St. Paul—The 68 counties in Minn. will carry out extensive rd. bldg. program. State Hwy. Comr., C. M. Babcock, announced that each county will be given state aid to amt. of $22,500; the County itself adding to this amount $25,000 to $75,000.

Mo., Liberty—$500,000 bonds to me issued by Clay Co. Comrs. (to be supplemented by $500,000 Govt. and State appropriation) for construction of 60 miles bitum. macad. rd. — Kans. City and Clinton Co. line; N. Kans. Co. via Avondale, Winnwood and Liberty to Excelsior Springs; Liberty and Holt via. Kearney.

Mo., Maryville—$1,000,000 bond issue being considered by Nodaway County for purpose of bldg. hard surfaced roads.

Mo., Oregon—Holt County will hold elec. on issuance of $990,000 bonds for hard surf. roads. Jno. H. Peret, Co. Survy.

Mo., St. Louis—City considering improving following: Juniata St.—Iouisiana to Ark. Aves., tolford base and macad.; also macad. surf. Est. cost, $6,000; Tiffany St. —Rutger to Chouteau Aves.—conc. base and brk. surf., $8,900; Mulentz Ave., Gravois Ave. to Kingshighway—conc. base and brk. surf., $17,250.

Mo., St. Louis—If Madison Co., Ill., votes favorably on $600,000 bond issue, this city will have hard rd. to Chicago, and one to New York City. Fed. and state aid to amt. of $214,650 each, making total funds available, $1,030,000.

Mo., St. Louis—Madison County has voted $600,000 for road improvt's. This money, with addn. $400,000 state and fed. aid will be used to build 67 mi. hard roads.

Mo., Kans. City—Clay County has authorized issuance of half a million dollars of the 1¼-million bonds voted for good roads throughout county.

Mont, Helena—23 counties in this state will expend $812,000 for road bldg. this year. 27 projects planned.

Mont., Red Lodge—Carbon Co. will build following rds. (Fed. aid.): Bear Creek-Washoe Rd., $14,034 and Laurel-Billings Rd., $19,305. H. P. Sandels, Co. Clk.

N. J., Jersey City—Bd. of Freeholders, Hudson Co., will soon call for bids for improvt. of Hudson County Blvd. Est. cost, $500,000.

N. J., Trenton—City Comm. considering paving 2, and improving 7 streets. Approx. $70,000 and $28,000 respectively. Leon D. Hirsch, City Clk.

N. J., Trenton—Maj. Gen. Geo. M. Goethals, Supvrs'g. Engr., N. J. Hwy. Sy., on which $15,000,000 will be expended, has filed report with State Hwy. Comm. Taxes will make available $3,165,000; for repair work in various counties, $2,900,000 from motor vehicle dept.

N. J., Paterson—J. MacDonald, Director, Passaic Co., planning to pave and improve streets and roads at approx. cost $204,714.

N. J., Verona—Improvement of Bloomfield Ave.—Verona to W. Caldwell—being considered. Est., $375,000.

N. M., Albuquerque — City considering paving Albuquerque-Santa Fe Hwy. — Mountain road to Sandoval county line with conc. Est. cost, $28,000. Project is virtually certain as Col. Alfred Grunsfeld, Chrmn., Co. Comrs., has agreed to appropriate Bernahllo County's share of cost of the improvt.

N. Y., Albany—Residents are urgently demanding constr. of boulevard across Jamaica Bay from Woodhaven to Rockaway Peninsula. Est. cost, $100,000.

N. Y., Albany—Bills to appropriate $3,787,383 for hwy. constr. maintenance and repair work introduced in the Legislature by Chrmn. Sage and Machold of Finance Comm.

To Owners of Industrial Plants

Every steam plant consuming five (5) tons of coal per day should employ some adequate method of checking its boiler and furnace efficiency.

The price of ignorance is waste. These must be replaced by *Knowledge and Efficiency.*

There are, broadly speaking, two methods for checking boiler room efficiency.

1—Daily accurate measurements of coal and feed water

2—Systematic flue gas analysis

Both methods should be employed in a plant of large size.

You are requested to place your boiler plant under as careful system of Accounting and Supervision as any production department of your business.

Nothing will more effectively assist your fireman in getting high results from the coal than to provide means for determining what results he is getting.

United States Fuel Administration

N. Y., Brooklyn—Mr. Reigelmann, Boro. Pres., is requesting appropriation of $1,500,000 for repairing city's streets.

N. Y., Manhattan—Bd. of Estimates has allotted $3,500,000 for street improvements as follows: Manhattan, $2,000,000; Brooklyn, $600,000; Bronx, $400,000; Queens, $300,000 and Richmond, $200,000. 27 streets and avenues leading to ferries and steamship piers will be repaved with granite blk. of most modern type; 48 will be re stored with sheet asphalt.

N. Y., Rochester—City considering paving with asphalt Bay St.—Portland Ave. to Webster Ave.; and Norton St.,—Portland Ave. to Waring Rd. Est. cost, $130,000 and $122,000, respectively.

N. Y., Rochester—City considering paving Main St., E., with asph. block. Approx. cost, $109,080. C. A. Poole, Acting City Engr.

N. Y., Boro of Queens—Bd. of Est. voted $2,061,364 for opening and extending Queens Blvd. Total cost of improvt. will be $4,000,000. Blvd. is to extend from short dist. east of Queensboro Brdg. to Hillside Ave., in Jamaica—8 miles long and 200 ft. wide.

N. Y., Yonkers—Resolutions drawn up authorizing City Engr. to prepare plans for surfacing Yonkers Ave.—present end of paving at Ashburton Ave. to Dunwoodie Sta.; McLean Ave.,—Kimball to Cehtral Pk.; short stretch on Tuckahoe Rd.—Nepperhan Sta. to Saw Mill River road.

N. D., Bismarck—Plans completed by State Hwy. Comm., for 290 miles of Fed. aid hwy. in early spring in various counties.

Ohio, Akron—County Hwy. Comrs. advise that state hwy. to Cleveland is practically assured. State aid, $200,000. Est. cost of road, $600,000.

Ohio, Bowling Green—$128,000 rd. bonds have been sold. Funds will be used for improving Dixie Hwy.—Bowling Green to Trombley.

Ohio, Canton—Plans under way to build hwy.—Osnaburg to Minerva. Fed. aid to amt. of $10,000 a mile.

Ohio, Canton—Seven new paving jobs are planned for this year as part of program involving expenditure of $133,000 to $133,100.

Ohio. Cincinnati—Dixie Hwy. Comm. plan to raise $10,000 for completion of strip of 12 miles betw. Richmond, Ky., and Knoxville, Tenn.

Ohio, Cincinnati—Clearmont County Commr. have decided to issue $200,000 bonds for road improvement. State is expected to appropriate equal amount, and three of the proposed cross county roads will soon be under way.

Ohio, Conneaut—Highway betw. here and Ashtabula will be paved this year—will be 12 miles long and 20 ft. wide. Approx. cost, $36,000 per mile. Govt. will ship war supplies and munitions over this rd., which fact will hasten its improvement.

Ohio, Dayton—Work will commence soon on improvt. of more than 40 miles Montgomery Co. rds.; 27 mi. being main market and inter-county rds. State aid to amt of $150,000.

Ohio, Kenton—Co. Comrs. considering paving of Lincoln Hwy. with brk. through Hardin Co. Approx. cost, $765,000. Jas. S. Wetherhill, Co. Survy.

Ohio, East Liverpool—City expects to spend abt. $200,000 for extensive road and street improvements. Abt. largest piece of street work will be repaving St. Clair Ave.—the Diamond to entrance to Riverview Cemetery.

Ohio, Tiffin—Co. Comrs. requested to improve So. Sandusky St.—Big Four R. R. to city limits. Two-course waterbound macad. rd. being considered. Est. cost, $25,000. (May be packed down couple of yrs. then asph. treated.)

Okla., Lawton—Fort Sill Blvd., 5 miles long, from Lawton to Military Reservation, probably will be paved or macadamized.

Okla., Okla. City—About $1,250,000 available for hard surfaced roads throughout state. Max L. Cunningham, State Engr.

Ore., Salem—State Highway Dept. has received Federal Government's approval on 18 miles of Post Road project on Pacific Highway north of Salem, and construction will begin in about 2 weeks. Total cost of project estimated at $348,000,000.

Pa., Cambridge Springs—Crawford Co. has available $48.591 state aid and $110,000 state hwy.

Pa., Harrisburg—Part of $500,000 appropriation given State Hwy. Dept. by War Bd. will be used to improve last half-mile in Penn., of the national pike. Est. cost, $40,000.

Pa., Kittanning—State Hwy. Comr. O'Neil has announced that there will be $62,000 state approp. available for expend. on state rd. this year. This will mean an expenditure of $120,000 for new rds. in Armstrong Co.

Utah, Ogden—Approx. $300.000 will be expended by Government on roads in this state, and probably more than $1,000,000 in Ogden forestry dist.

Utah, Provo—Utah County contemplates bond issue of $1,000,000 for construction of concrete highway system. Ben Argyle, Co. Engr.

Utah, Salt Lake City—Secy. of Agriculture has approved of four rds.—abt. 120 mi.—to be constructed within next two years. Est. cost, $175,000. Ira R. Browning, State Rd. Engr.

Utah, Salt Lake City—Salt Lake Rotary Club has recommended to State Hwy. Comm., abt. 30 miles surface gravel for Wendover Hwy. This road traverses Salt desert west of city.

Texas, La Grange—Surveys being made for 22 miles bitum. gravel rds. Est. cost, $150,000. A Shafley, Co. Engr.

Texas, San Antonio—Fed. Reserve Bd., Washington, has given permission to float $1,000,000 bond issue here for civic improvments.

Va., Norfolk—City planning appropriation of $90,000 for paving and improving streets betw. Lambert's Point and army base.

Va., Portsmouth—Decision made by War Department to expend abt. $200,000 in construction of streets and sewers in and around old Norfolk Navy Yd.

Texas, Temple—$1,900,000 bonds have received approval of Attorney for purchaser and funds will soon be available.

Wash., Hoquiam—Among the proposed hwy. improvts. to be undertaken this yr., by State Bd., are the following: 10 or 12 mi. on Olympia Hwy.; 2 mi. of rd. along south side of Lake Quinault; grade and gravel 3½ mi. betw. Lake Quinault and Forks; 4 mi. of rd. south from Forks toward Jefferson Co. line. Jas. Allen, Olympia, State Hwy. Comr. Geo. F. Cotterill, Hwy. Engr.

Wash., Ritzville—Adams Co. Comrs. have adopted resolution for construction of perm. highway leading east from Haton—7 miles.

Wash., Seattle—State Hwy. Engr., Jas. Allen, assures Chelan Co. Comrs. that $70,000 is available for improv'g. Blewett Pass Hwy.—grading operations will proceed as soon as weather permits. He will request additional appropriation of $40,000 Fed. aid for further improvts. on this road.

Wash., Seattle—Plans for street paving for 1918 approved by Bd. Pub. Wks. Work includes connect'g. up Rainier Ave. to So. city limits at Ryan St. 6 sets of plans prep. for work. Est. cost, $285,000; W. Spokane St. and others will be graded and paved. Plans also approved for paving Boyer Ave, 12th Ave., North and Fuhrman Ave. from 23rd to Eastlake Ave. Est., $71,318. Total cost of improvts. in excess of $500,000.

Wash., Seattle—$152,000 available for rd. imprvts. in Klickitat Co. White Salmon-Trout Lake Rd. will be gravelled—White Salmon to Husum; Snowden-White Salmon rd. will receive special attention (heavy grades and sharp curves eliminated)—6 mi. will be gravelled. It is also planned to install 2 new Aurora rock crushing plants comp. Geo. W. Borden, Goldendale, Wash., Co. Engrs., will have entire charge of work.

Wash., Tacoma—Plans soon to be started by Co. Engr. D. H. White, for paving 3 mi. of hwy. in vicinity of Orting. Approx. cost betw. $17,000 and $22,000. $104,000 available for constr. of new rd. to Camp Lewis.

Wash., Walla Walla—County considering bldg. following highways: Huntsville through Waitsburg, Walla Walla, Wallula, Attalla and Burbank to Snake River; Walla Walla to Prescott; Milton to Elgin; Walla Walla south to Oregon line through Pendleton.

W. Va., Huntington—Wayne Co. Will vote March 29th on bond issue in sum of $1,000,000.

Wis., Madison—Bids will be asked about June 1st for laying 20,000 sq. yds. sheet asphalt. and conc. paving. E. E. Parker, City Engr., $50,000.

Wis., Superior—City Engr. has prepared plans for 18,000 sq. yds. brick, and 8,700 sq. yds. conc. paving. Bids to be asked soon.

Wyo., Cheyenne—Work to begin in spring on five roads as follows: Warren Rd., Niobrara Co.,—7½ mi.; Lyman Rd., Uinta Co.,—1½ mi.; Urie Rd., Uinta Co.,—4 mi.; Big Piney Rd., Lincoln Co.,—6 mi.; Sprg. Canon Rd., Converse Rd. south of Douglas,—8 mi. Z. E. Sevison, State Hwy. Engr.

National Sabotage

By EMERSON HOUGH

(January 12, 1918, issue of *Leslie's Weekly Newspaper)*

"By a hasty 'rider' passed at the past session of Congress, the postage on periodicals was increased from 50 to 900 per cent. by a 'zoning' system. This was not a war tax, for publishers and readers are subjected to all the regular taxation of the War Revenue Bill. It is legislation that would inevitably suppress the habit of reading.

"Unless this law is repealed, the great national press will be destroyed and sectional periodicals only can survive.

"A magazine or newspaper without circulation is of no use to the Government or to the public. A magazine which cannot buy material of interest has no circulation. Without circulation, it cannot have advertising.

"Shut the publishing doors of America and this war is lost today and there will be no more tax raised by this or any future administration of America. We shall have anarchy and nothing better.

"The zone rate of second-class postage is Administration sabotage committed in a time of high-strung zeal. The American periodicals are as important as the American railroads in carrying on this war. Why wreck either?"

SEWERAGE AND SEWAGE TREATMENT.

Cal., Blythe—A. P. Campbell, C. Engr., Riverside, has been retained by City to make estimate of cost of sewer system.

Cal., Los Angeles—City Council has authorized Budget Comm. to provide $32,000 for purpose of construct'g. sewage pumping plant at Manchester Ave., and Figueroa St.

Cal., Seal Beach—$45,000 sewer bonds voted recently. Plans prepared by Olmsted & Gillelen, Engrs., Hollingsworth Bldg., Los Angeles.

Del., Laurel—Elec. to be held to vote on $60,000 for improving sewers and streets.

Ga., Macon—City contemplates bldg. san. sewer system. Will vote on bond issuue in sum of $300,000.

Ill., Springfield—City considering extension of town branch sewer. Est. cost, $100,000.

Ind., Kokomo—City considering bldg. 3 mi. sewer, involving 8 and 12-in. tile. Approx. cost, $20,990. E. Hunt, Kokomo Trust Bldg., Engr.

Ia., Ft. Madison—City contemplating construction of new up-to-date san. sewer system. Residents strongly in favor of same.

Ia., Gilmore City—Bids soon to be asked by Town Clk., for construct'g. sewerage sys., involv'g. 9,000 ft. of 8 to 15-in. pipe, settling tank and sprinkling filter. C. H. Currie, Webster City, Ia., Engr.

Ia., Montezuma—Plans for a sewage treatment plant have been del. to the City Council by J. H. Dunlap of Iowa City, Ia. Bids will soon be received.

Kans., Belleville—This city will have a system of sanitary sewers and a sewage treatment plant under plans prepared by Black & Veatch, Consulting Engr., Kansas City, Mo.

Kans., Wichita—City considering sewer construction in Hill Dist. to be known as Sewer Dist. No. 15. Abt. $90,000. P. L. Brockway, City Engr.

La., Camp Beauregard—New sewerage system will be installed here this spring. Approx cost, $400,000.

Md., Hagerstown—Plans being prepared for construc. of storm water and san. sewers, by J. B. Ferguson & Co., Engrs., 43 E. Jonathan St. Est. cost, $80,000.

Mass., Boston—Ord. passed providing for appropriation of $600,000 for construction of sewerage works.

Mass., Wellesley—City considering construction of 12,000 ft. sewer as balance of sewer from here to Metropolitan sys. Wk. involves 1,300 ft. rock for tunnel, bal. earth trenching and laying 33x36; also 36x40-in. concrete pipe. City also plans to install sewers in various sections. Total expenditure, abt. $60,000.

Mich., Detroit—Village of Hamtramck is considering bldg. 15 miles of sewers north of Caniff road; also $100,000 bond issue to cover cost of improvements.

Mich., Detroit—Bd. of Estimates has approved expenditure of $6,500,000 for sewer construction for this year.

Minn., Minneapolis—Resolution adopted for issuance and sale of $250,000 bond for laying main and trunk line sewers.

Minn., Minneapolis—$250,000 will be expended for trunk line sewers.

Mo., Cape Girardeau—Until Mar. 18th, by Chris. E. Stiver, City Engr., for constructing comb. san. and storm sewerage system. Est. cost, $250,000. Plans, specifs., etc., from R. W. Frissell, City Clk.

Neb., Fremont—Ord. passed by Council to hold elec. for purpose of voting on $75,000 bonds for new sewage disposal plant.

N. J., Jersey City—City will soon ask bids for replacing 16-in. cem. sewer in Palisade Ave.—Franklin to North Sts.—with 20-in. c. i. pipe sewer. C. Van Keuren, City Engr.

N. J., Wrightstown—Town considering bond issue of $30,000 for bldg. sewerage system.

Pa., Erie—Plans being prep. by Gannett, Seelye & Fleming, Engrs., 204 Locust St., Harrisburg, for rav. sewerage sys., disp. plant. and intercepting sewers. Abt. $800,000. F. G. Lynch, City Engr.

Ohio, Salem—City will issue $35,000 bonds to rebuild sewage treatment plant. B. M. French, City Engr.

N. Y., Bronx—City authorities are planning E. Bronx sewer; ultimate end of work is that all sewage would be brought to main trunk outlet of sewer at White Plans Rd., with view of install'g. sewage disp. plant at that point.

N. Y., Glens Falls—City has had surveys made by H. W. Taylor, Engr., 100 State St., Albany, of present sewerage sys., with comp. plans for improvt. to include relief sewers, extensions and sewage disp. plant.

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N. Y., Rochester—Under annexation bill City will have to construct one (possibly two) additional sewage disp. plant; one will be located within limits of Maplewood Park.

Ohio, Columbus—Ord. passed providing for issue of $100,000 bonds to construct Franklin Park Extension sewer; also bond issue for $85,000 to pay cost of construct'g. Shepard main trunk sewer.

Ohio, Kenmore—$75,000 bonds to be sold for bldg. storm water sewers in village.

Ohio, Lima—Council passed resolution authorizing service director Metheany to employ expert engineers to draw up plans for comprehensive sewage collection system, to include main trunk sewers in nearly every section of city.

Ohio, Rocky River—Bids soon to be asked for storm and san. sewers. Est. cost, $100,000. Work includes main sewer along Beach Cliff Blvd.—W. Lake rd. to north end of village. Approx. 16,500 lin. ft., 8 to 24-in. san. vitr. tile pipe; 16,500 lin. ft., 12 to 18-in. storm sewer. E. H. Arnold, Engr.

WATER SUPPLY AND PURIFICATION.

Cal., Prawley—$80,000 bonds voted by N. End Water Co., for improv'g. water wks. plant, including conc. dam for storage purposes.

Cal., Redding—Plans prepared for water system. Est., $221,230. W. A. Cooper, Engr., Mills Bldg., San Francisco.

Kans., Parsons—Preliminary plans for filtration plant prepared by Black & Veatch, Con. Engrs., Kansas City, Mo.

Mich., Ann Arbor—City will soon vote on $200,000 bonds for the purpose of bldg. pumping sta., also wooden pipe line, to supply 3,000,000 gals. of water daily.

Minn., Crosby—$132,000 bond issue to be voted on soon for constructing waterworks system. H. L. Nicholson, City Clk.

N. Y., Buffalo—Preliminary plans being prepared for construction of 8 mi. water mains. Est. cost, $150,000. G. H. Norton, City Engr.

N. M., Roy—Election to be held soon for voting on $45,000 bond issue for constructing water system. V. K. Jones, Engr.

N. C., Charlotte—The City contemplates spending $75,000 to increase capacity of local Water Works. City Engineer Lea in charge.

Ohio, Lorain—Ord. passed to issue bonds to amt. of $90,000 for extending and enlarging waterworks sytsem. C. L. Patterson, Clerk.

Ore., Ontario—Bids will be asked immediately for constr. of water sys. Plans by Louis C. Kelsey, Portland, include pumping plant at Snake River and filtering and chlorinating plant. Bonds to amt. of $100,000 voted.

Okla., Kingfisher—Black & Veatch, Engrs., 507 Interstate Bldg., Kansas City, Mo., are preparing preliminary plans for waterworks system. J. A. Eggleston, City Clerk.

BRIDGES AND BUILDINGS.

Ark., Connery—Plans for 2 steel bridges across Cache River near Augusta have been sent out by State Highway Dept. Bridges are of steel construction and estimated cost is $20,000 each.

Ga., McRae—A steel bridge is planned across the Oconee River just west of Mt. Vernon. It will be built jointly by Montgomery and Wheeler Counties. Estimated cost, $60,000. Garrett & Slack, Montgomery, Ala., consulting engineers.

Ga., Valdosta—State Hwy. Comn., Atlanta, has approved brdg. over Withlacoochee River, Lowndes Co. Est. cost, $30,000.

Miss., Gulfport—$600,000 bonds to be issued for bldg. conc. brdg. or causeway across Bay St. Louis, 2 mi.; this to complete link in Spanish Trail Hwy. Harrison Co., Hancock Co. Comrs. & State Hwy. Dept. interested.

Mont., Helena—Cascade Co. will submit bonds for constr. of two brdgs. across Missouri River in 2 separate propositions. Cost of one is abt. $231,000; the other, $224,000. Temporary brdg. will be erected in connection with first structure at est. cost of $12,000.

N. Y., New York—Another bridge is planned to span the East River to connect the Bronx with Queens at Whitestone, close to the end of Long Island Sound. Plans for bridge are completed, and filed with Borough Prest. Bruckner of Bronx. Bridge will have span $3,000 ft. long.

N. Y., Schenectady—General Wotherspoon has given assurance to City & Co. officials, also residents of Rexford & vicinity, that new bridge will be built over aqueduct 4 mi. below this city. Appropriation will be made for brdg. with span of 250 ft.

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Bids received until April 9, 1918.

CONCRETE BRIDGE.

Shakopee, Minn.

Bridge Advertisement: Sealed bids will be received at the office of the County Auditor of the County of Scott, in the City of Shakopee, Minnesota, until 11 o'clock a. m., April 9, 1918, for building state bridge No. 2442 on state road No. 7 in the County of Scott, State of Minnesota. The superstructure will be 200 feet in length, 24 feet roadway, concrete floor, on concrete foundations. Distance from top of floor to bottom of foundations about 18 feet. Plans and specifications may be seen at the above named office, or at the office of the State Highway Commission at St. Paul. Plans are to be submitted by the respective bidders, which shall comply with the specifications of the State Highway Commission.

Each proposal must be accompanied by cash or a certified check for not less than 5 per cent. of the amount of the bid, payable to the County Treasurer of said Scott County. All bids must be upon the blank forms furnished by the undersigned. The Board reserves the right to accept or reject any proposal.

A. J. MAYER,
County Auditor, Scott County, Minn.

Bids received until April 9, 1918.

PERMANENT HIGHWAY No. 11-C.

Sealed bids will be received by the Board of County Commissioners of King County, Washington, until 10 o'clock a. m., April 9, 1918, for the construction of Permanent Highway No. 11-C, Auburn-Enumclaw Road.

Each bid must name a lump sum as specified and be accompanied by a certified check for 5 per cent. of the amount of bid.

A deposit of $5.00 will be required for plans and specifications, said sum to be forfeited unless same are returned on or before the date of opening bid.

The right is reserved to reject any and all bids.

Dated, Seattle, Washington, March 4, 1918.

BOARD OF COUNTY COMMISSIONERS
OF KING COUNTY, WASHINGTON.
By NORMAN M. WARDALL,
Clerk of Board.

By P. P. BLISS, Deputy.

(Also at same time and place and under same conditions, bids will be received for construction of Permanent Highway 2-K, Juanita-Houghton Road, and Permanent Highway 2-J, Wayne-Juanita Road.—Editor.)

Bids received until April 9, 1918.

SNOQUALMIE RIVER BRIDGE.

Sealed bids will be received by the Board of County Commissioners of King County, Washington, until 10 o'clock a. m., April 9, 1918, for the construction of a bridge over South Fork of Snoqualmie River at North Bend.

Each bid must name a lump sum as specified and be accompanied by a certified check for 5 per cent. of the amount of bid.

A deposit of $5.00 will be required for plans and specifications, said sum to be forfeited unless same are returned on or before the date of opening bid.

The right is reserved to reject any and all bids.

Dated, Seattle, Washington, March 5, 1918.

BOARD OF COUNTY COMMISSIONERS
OF KING COUNTY, WASHINGTON.
By NORMAN M. WARDALL,
Clerk of Board.

By P. P. BLISS, Deputy.

Bids received until April 9, 1918.

GRADING AND GRAVELING.

Shakopee, Minn.

Notice of receiving proposals: Sealed bids will be received at the office of the County Auditor of Scott County, at Shakopee, Minnesota, until 11 o'clock a. m., April 9, 1918, for the construction and furnishing of materials for the following road job in said County, to-wit:

Job No. 5 on state road No. 7, consisting of grading and graveling.

Plans and specifications may be seen at the above named office or at the office of the State Highway Commission at St. Paul.

Each proposal must be accompanied by cash or a certified check or bidder's bond for not less than 5 per cent. of the proposal, payable to the County Treasurer of said County. All bids must be upon the blank forms furnished by the undersigned.

The Board reserves the right to accept or reject any proposal.

A. J. MAYER,
County Auditor, Scott County, Minn.

Bids received until April 10, 1918.

ROAD WORK.

Glenwood, Minn.

Sealed bids will be received at County Auditor's office of Pope County, at Glenwood, Minn., until 2 o'clock p. m., April 10, 1918, for the construction of County road jobs numbered 1801 to 1805, inclusive. Plans and specifications may be seen at my office or State Highway Commission, St. Paul, Minn. Each proposal must be accompanied by certified check for not less than 5 per cent. of the amount of the bid. The County Board reserves the right to reject any and all bids.

The jobs consist of the following work:

78,472 cubic yards earth excavation, estimated cost, $19,618.00.

5,742 cubic yards earth excavation, estimated cost, $861.30.

Head walls, hauling and placing of culverts, $2,455.89.

Total amount, $22,934.19.

Dated at Glenwood, Minn., March 6, 1918.

OLE IRGENS,
County Auditor.

Bids received until April 11, 1918.

STREET PAVING.

Lake Alfred, Fla.

The Town of Lake Alfred, Florida, will let street improvement work on April 11, 1918, bids closing at 1:30 o'clock p. m.

About 15,000 square yards of asphalt concrete paving; about 65,000 square yards of clay paving; about 48,000 cubic yards of earth excavation.

Engineer in charge, J. W. Turner, Lakeland, Fla.

Town Clerk, C. F. Jester, Lake Alfred, Florida.

Bids received until April 12, 1918.

ROAD WORK.

Centreville, Tenn., March 6, 1918.

Sealed bids for the improvement of public roads in Hickman County, Tennessee, will be received by the Highway Commission of Hickman County until 12 o'clock noon, Friday, April 12, 1918, and at that time publicly opened in the Court House at Centreville, Tenn.

Proposed improvement includes the grading of approximately 100 miles of road, requiring approximately 500,000 cubic yards excavation and necessary drainage structures.

This improvement will be the last portion of the work let of a system of roads designated under the recent $225,000 bond issue, amounting to approximately $175,000.

Each proposal must be accompanied by certified check of twenty-five hundred dollars ($2,500.00) made payable to T. H. Erwin, Secretary, Hickman County Highway Commission.

Plans and specifications will be on file at the office of T. C. McEwen, County Engineer, Centreville, Tenn., on and after March 20, 1918.

A bond to secure performance of contract and the payment of all claims for labor and material will be required, in accordance with Chapter 182, Acts of 1899, State of Tennessee.

The Highway Commission reserves the right to reject any and all bids.

(Signed.) T. H. ERWIN, Secretary.

Bids received until April 15, 1918.

DRAINAGE WORK.

Dane County, Wis.

The Commissioners of the Clark Addition to the Rattlesnake Drainage District, Dane County, Wisconsin, will receive bids for constructing the work of said District at any time until the 15th of April, 1918, at the office of Hall, Baker & Whitcomb in the city of Madison.

Bids will be open April 16th, 1918, at 2 p. m.

Commissioners reserve right to reject any and all bids.

Copy of specifications and blue prints can be had by applying to Hall, Baker & Whitcomb, 23 Tenney Bldg., Madison, Wisconsin, enclosing $2.00 for printed copy of specifications and blue prints.

HALL, BAKER & WHITCOMB,
Attorneys for the Commissioners.
23 Tenney Bldg., Madison, Wis.

Bids received until April 15, 1918.

LEVEE RECONSTRUCTION.

MUSCATINE ISLAND LEVEE DISTRICT.

Muscatine, Iowa.

Sealed bids will be received by Muscatine Island Levee District at the office of the County Auditor, Muscatine, Iowa, until 11 o'clock a. m., April 15, 1918, for approximately 97,000 cubic yards of levee reconstruction.

The work is adapted to suction dredge, or may be done in part by drag line excavator and in part by teams.

Plans and specifications may be seen at the office of the County Auditor, Muscatine, Iowa, or at office of the Engineers.

For further information, apply to Elliott & Harman Engineering Company, Peoria, Illinois.

FORTY-EIGHT MILES OF ROAD.

Bids received until April 16, 1918.

Sealed proposals will be received at the office of the State Highway Department, Lansing, Michigan, until 1:30 o'clock p. m., Tuesday, April 16, 1918, by Frank F. Rogers, State Highway Commissioner, for improving approximately 48 miles of road in Baraga County, from the Marquette County line to the Houghton County line. The improvement will consist of clearing the right-of-way, shaping the road, constructing 698 lineal feet of retaining wall and constructing the necessary drainage structures. About 1½ miles of the road, in the villages of Baraga and L'Anse, are to be surfaced to a width of 16 feet with concrete.

Proposals will be received on separate sections of the work and on the whole work complete.

Plans may be examined, and instructions to bidders, specifications and proposal blanks obtained at the office of the State Highway Department, Lansing, Michigan, and at the office of H. A. Brennan, Prosecuting Attorney, L'Anse, Michigan. Prospective bidders are also referred to G. C. Dillman, District Engineer, 700 S. Charlotte St., Escanaba, Michigan, for information relative to the work.

A certified check in the sum of five thousand dollars ($5,000), made payable to the State Highway Commissioner of Michigan, must accompany each proposal for the whole work, and each proposal for a separate section must be accompanied by a certified check in the sum of one thousand dollars ($1,000), except that one bidder will not be required to submit certified checks in a sum greater than five thousand dollars ($5,000).

The right is reserved to reject any or all bids.

FRANK F. ROGERS,
State Highway Commissioner.

Bids received until April 17, 1918.

GARBAGE REMOVAL AND DISPOSAL.

Baltimore, Md.

Sealed proposals in duplicate, addressed to the Board of Awards of Baltimore City, will be received at the office of the City Register, City Hall, Baltimore, Md., until 11 o'clock a. m., Wednesday, April 17, 1918, for the purchase, reception, removal and final disposition of garbage from all sources and dead animals within the limits of Baltimore City for a period of eleven years commencing January 1, 1919, and ending December 31, 1929.

Specifications and proposal forms may be obtained at the office of the Commissioner of Street Cleaning, City Hall Annex No. 2, Baltimore, Md., on and after February 23, 1918. A charge of $5.00 will be made for each set of specifications. This amount will be refunded upon their return before April 30, 1918, in good condition. Specifications used in making a bid will be considered as returned.

All bids must be accompanied by a certified check of the bidder on a clearing house bank payable to the Mayor and City Council of Baltimore for $2,000.00, and the successful bidder will be required to give satisfactory bond of $40,000.00 for the faithful performance of the agreement.

The Board of Awards reserves the right to reject any or all bids.

WM. A. LARKINS,
Commissioner of Street Cleaning.

Approved:
JAMES H. PRESTON,
President Board of Awards.

Approved:
FRANK DRISCOLL,
Assistant City Solicitor.

February 18, 1918.

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BACK NUMBERS OF MUNICIPAL ENGINEERING.

We need a few copies of MUNICIPAL ENGINEERING for January, 1906, vol. 30, No. 1; November, 1910, vol. 39, No. 5; December, 1915, vol. 49, No. 6. We will extend the subscription for two months of any one sending a copy of either of these or six months for all three. Send word by card or letter of mailing the magazines, so that you will be sure to get the credit.

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WANTED—Salesmen to sell our line of culmination excavators and loaders. This machine travels a good rate of speed—excavating for subgrade as it goes along and delivering excavating material into trucks or wagons. Digging wheel cuts from 2 to 3 inches to 3 feet deep and elevator is adjustable to load into any truck or wagon. Will be a big seller on road work this spring. Address "Grader and Motor," care of Municipal Engineering, 538 S. Clark St., Chicago.

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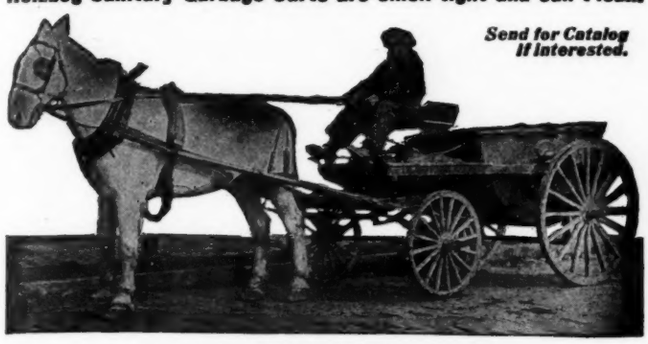

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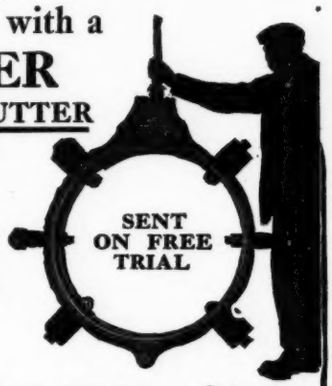

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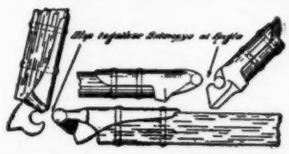

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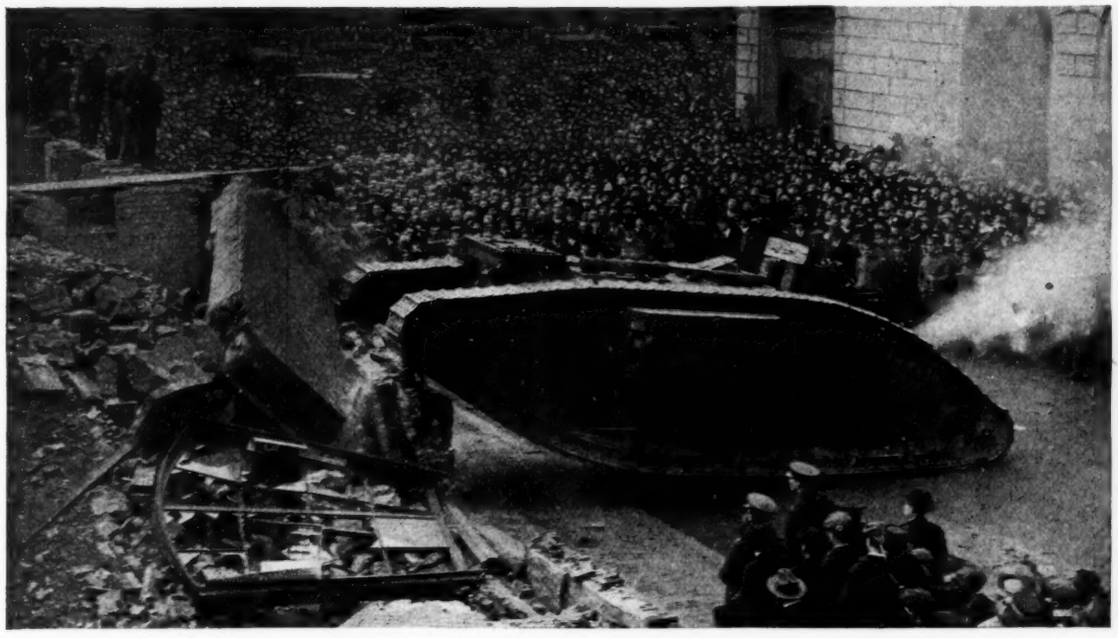
BITULITHIC stands the test of War Tank



(Photo by courtesy of ***Boston Herald***)

Veteran British War Tank "Britannia" on *Bitulithic Pavement* on
Trinity Place, Boston, Mass. (Trinity Place is "opposite Copley Plaza Hotel, Westminster Hotel and Trinity Church")
Demolishing old brick walls two feet thick of old Massachusetts Institute of Technology Laboratory Buildings.

THE "BRITANNIA," *weighing over 30 tons,*
traveled over the **Bitulithic** Pavements on
Dartmouth Street, laid on old macadam, 1903. Winter Street, laid on concrete base, 1913.
Trinity Place, laid on concrete base, 1914. Commonwealth Ave., laid on old macadam, 1916.
Without causing any damage to the pavement, notwithstanding

The "Tank" proceeding through crowd preparatory to demolishing the wall.

After demolishing the wall and proceeding of the "Tank" to other activities.

The extremely heavy weight and the cleats on the caterpillar belts.
The huge weight being supported by the inherent stability and great density of the **Bitulithic Surface Mixture.**

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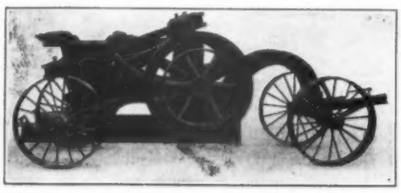
From the crushing of rock to the finishing of the surface with oil binders, the **Austin-Western Line** furnishes suitable equipment for every process; it comprises:



Western Portable Crushing Outfit.
(Made in three sizes.)

Aurora Rock Crushers
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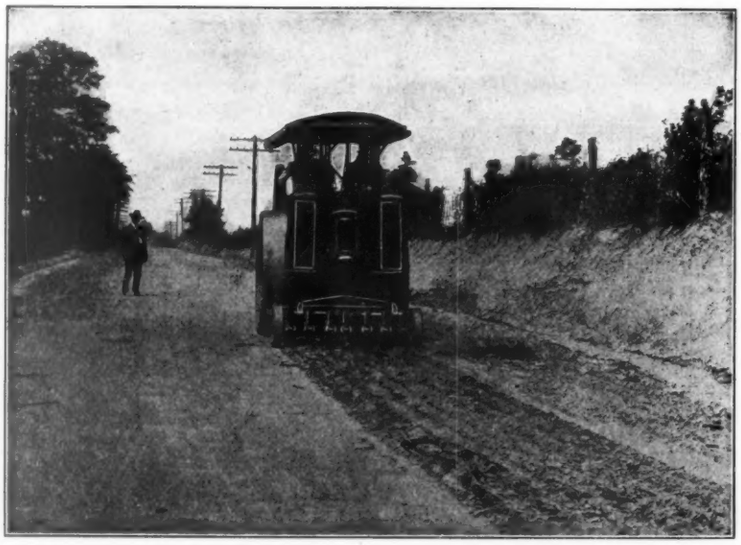
Every item made in a variety of styles and sizes to suit the job.

Write for catalogue 18—it covers the whole line.



Scarifying in Florida with Austin Roller and Attachment.

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